

GOVERNANCE UNDER UNCERTAINTY: TASK ASSIGNMENT IN PRODUCER
CONTROLLED RESEARCH ORGANIZATIONS

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Saskatoon

by

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Abstract:

In Canada, Australia, United States, and a number of other countries there are considerable number of producer controlled research organizations (PCROs) in the agricultural sector, charged with the task of investing hundreds of millions of dollars in research and development (R&D) projects. Given the impact of PCROs on productivity of agricultural sector and food security, the primary objective of this study is to improve the governance of PCROs by providing knowledge of the decision-making process and governance structure of these producer-led entities. The information related to the current governance structures and decision-making processes of PCROs is attained through analyzing a series of interviews with managers and directors of key PCROs in Australia, the U.S. and Canada.

A great deal of similarity was observed across PCROs both in terms of the decision-making process and governance structure. In particular, PCROs do not tend to separate management and oversight tasks. The producers elected directors of these organizations are involved in management decisions. This observed practice is in contrast with most of the theories and empirical studies focusing on the governance structure of non-profit (NP) and for-profit (FP) organizations (Brown & Guo, 2010; Fama & Jensen, 1983; LeRoux & Langer, 2016; Miller-Millesen, 2003). Based on information gained from the interviews, observable characteristics of PCROs explained in the literature, and agency theory this dissertation develops a theoretical model to describe the unusual task assignment in the PCROs. The theoretical model suggests that because of the long investment horizons in the PCROs, the compensation of management teams based on their contributions to return on investments is not feasible. Therefore, the PCROs have to reward their executives on the basis of a measure of efforts exerted. Hence, the directors' involvement reduces the volatility of managers' compensation. Motivated by the theoretical model, a survey whose participants are the directors of Saskatchewan's PCROs was conducted to examine the consistency of theoretical model's implications and the task assignment practices of PCROs in the real world. The examination of the survey results suggests the presence of consistencies between the theoretical model's implications and observed outcomes.

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DEDICATION

This work is dedicated to my parents Mahmoud and Seiddigheh, my wife and daughters, Zeinab, Zahra and Narges and my in laws Safdar and Mahin for their love and support.

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Chapter 1: Introduction

1.1 Problem statement

Innovation is a key source of economic growth (Romer, 1990; Solow, 1957). In most economies, the agricultural sector has experienced remarkably higher and faster rates of growth than other sectors (Moschini & Lapan, 1997). The notable growth rate of agricultural sector stems from the investments in agricultural research (Alston, Norton, Pardey, & Others, 1995; Alston & Pardey, 1996). However, in recent decades governments and the private sector have changed their agricultural research investment behaviors, which could negatively affect the growth of agricultural sector and endanger food security (Alston, Gray, & Bolek, 2012).

The failure of governments and the private sector to invest both sufficiently and efficiently in agricultural research has provided catalyst for the establishment of producer-controlled research organizations (PCROs). The organizations investigated in this dissertation are different than agricultural cooperatives and agricultural producers associations in which farmers are present at directors. PCROs are different than cooperatives because, as we explain later, PCROs have the non-distribution constraint and are considered as NP organizations. The PCROs do not have any residual claimants, as the shares are not defined in these entities. However, cooperatives distribute their profits amongst their members (Hansmann 1980). The PCROs should be also distinguished from the agricultural producer associations that are NP organizations by nature. This is because the PCOs are typically granted taxing power by governments while agricultural producer associations, as NP organizations, do not have such a power. Furthermore, the PCROs are specially tasked with investing farmers' checkoff in agricultural R&D and promotion projects while the tasks of agricultural cooperatives and agricultural producer associations include a wide range of activities including marketing, advocacy, distribution and so on.

Persistently very high rates of return to agricultural research (Hurley, Pardey, Rao, & Andrade, 2016), suggest that neither the private sector nor public sector has invested sufficient

resources in agricultural research. In turn, the roles of industry groups such as PCROs have increased in agricultural research funding (Alston et al., 2012; Alston, Pardey, & Smith, 1998).

In Canada, Australia, the United States and a number of other countries, there are a considerable number of PCROs in the agricultural sector. Collectively, they have been charged with the task of investing hundreds of millions of dollars in R&D projects with the objective of increasing the profitability of farming for the broad spectrum of members they represent. These producer-led organizations are increasingly operating in an environment where both private and the public entities are making investments, with the implication that PCROs must consider how to create synergy in research investment across the agricultural sector.

Studies suggest PCROs investments have had significant impacts on agriculture innovation and the welfare of the producers and consumers (Alston, Chan-Kang, Marra, Pardey, & Wyatt, 2000; Alston, James, & Pardey, 2011; Gray & Scott, 2003; Hurley, Pardey, Rao, & Andrade, 2016; Williams, 1999). The studies also show that PCROs can improve the efficiency of resource allocation (Alston, Freebairn, & James, 2004; Kangasnime, 2002). Because the board of directors of PCROs are farmers, they can respond to farmers' research interests (Klerkx & Leeuwis, 2008; Röling, Hounkonnou, Offei, Tossou, & Van Huis, 2004). The PCROs are also considered new players in the national innovation system of countries. The presence of these organizations changes the dynamic of the innovation systems because their contributions result in new connections and knowledge flows affecting other parties behaviors in the system (Klerkx & Leeuwis, 2008).

Increasingly PCROs may redirect the funds toward the projects benefiting the industry's stakeholders rather than society as a whole. This is specially the case if the PCROs and nations have different incentives in funding of agricultural research (Alston, Freebairn, & James, 2003; Alston et al., 2004). In addition, the increasing role of PCROs in research funding could worsen the market and government failures by crowding out other parties interested in research investment (Alston et al., 2003, 2004).

The returns on investments made in PCROs are accompanied with a great deal of delay. In a comprehensive study of U.S. public agricultural research investments, Alston et al. (2011) showed public agricultural research has measurable impacts 40 year after the investment was made, and the peak impact occurs 25 years after the investment is made. Similarly, PCRO investment outcomes are also realized several years after research investments are made.

Furthermore, the governance structure of PCROs, difference in producers' innovativeness, agency problem due to difference in the interests of decisions makers (Alston & Fulton, 2012), institutional lock-in (Froystad, 2012), high rate of spillovers and negative attitudes of producers about the effectiveness of PCROs' investments due to long investment horizon of these organizations (Gray, 2014) might results in the failure of these organizations to invest sufficiently and efficiently in agricultural research.

Despite the importance of PCROs, their impact on agricultural sector, described above and a generally strong record of past performance, reflected in many benefit/cost studies (Alston, James, & Pardey, 2011; Gray & Scott, 2003; Hurley, Pardey, Rao, & Andrade, 2016), the decision-making and governance structure of PCROs has been a subject of very little study.

1.2. Objective of the study

The goal of this dissertation research is to explore decision-making process and governance structure of these producer-led entities with the objective of creating public knowledge that can improve the PCRO governance. The exploration began with a survey of decision-making process of some of 14 key PCROs in Australia, Canada and the U.S. The survey revealed a great deal of similarities across PCROs. In particular, with one exception, PCROs do not separate management and oversight tasks. The members of board of directors charged with oversight of these entities are also directly engaged in research allocation decisions. The PCROs' task assignment practice is in contrast with most of the theories and empirical studies focusing on the governance structure of NP and for-profit (FP) organizations (Brown & Guo, 2010; Fama & Jensen, 1983; LeRoux & Langer, 2016; Miller-Millesen, 2003). To gain insight into this unusual behavior this dissertation develops a theoretical model to describe the task assignment in the PCROs based on the interviews, characteristics of PCROs and agency theory. Finally, hypotheses derived from the theoretical model are examined through a survey of the directors of grain PCROs in Canadian province of Saskatchewan.

As outlined in more detail below this exploration of PCRO decision-making has led to a better understanding of governance of PCROs and other organizations with long investment horizons or highly uncertain returns.

1.3. Dissertation content

1.3.1. Overview

To meet the objectives explained above, this doctoral dissertation encompasses three phases of interconnected research, which are presented as sequential chapters in this dissertation. This dissertation follows methodologies documented by Eisenhardt (1989), Eisenhardt and Graebner (2007) and Siggelkow (2007) to meet its objectives. The use of case studies to develop theories has become a common practice in management science (Eisenhardt & Graebner, 2007). This research method involves an examination of a series of cases to generate theoretical concepts. Building theories from case studies are based on induction, where each case is investigated separately and then the connections amongst the cases are taken into consideration. In this case, repetitive phenomena are highlighted to show the existence of a general logic in examination of cases. The next step includes documenting the analyses of cases in the context of existing theories and strands of literature to focus on the contribution of the examinations cases (Yin, 1994). Finally, as it is suggested by Siggelkow (2007) the theory created should have consistencies with the real world.

This study examines the governance structure and decision-making process of PCROs. Then it highlights the differences and similarities amongst these entities. Consequently, given the existing theories and literature, the study attempts to provide theoretical explanations of PCROs' governance structure. Finally, this doctoral dissertation tries to illustrate the theory developed has value as it is capable of explaining governance of PCROs in the real world.

The first study, presented in Chapter 2, describes the current governance structures and decision-making processes of PCROs, by analyzing information gained through series of interviews with managers and directors of key PCROs in Australia, Canada and the United States. An attempt is made to explain the nature of PCROs' functions in the context of theories related to the governance of non-profit (NP) organizations. Interestingly, with only one exception, PCROs do not separate management and oversight. This unusual task assignment practice, which is not consistent with the general practice of most non-profit and for profit organizations, is the basis of the subsequent chapter of this doctoral study.

Chapter 3 of this dissertation develops a theoretical model to describe the unusual task assignment in the PCROs. This novel agency based theoretical model allows the examination of several factors on the weight assigned to the board of directors in the decision-making process.

The factors include uncertainty in output and input measurement, types of compensation schemes, the relative quality of decision-making of directors and managers, altruism and learning capacity of directors. Motivated by the implications of the theoretical model, two testable hypotheses are developed, which are examined in the subsequent chapter.

Chapter 4 reports the results of a survey focusing on the board members of Saskatchewan's PCROs. The results show some consistencies between the hypotheses posited by the theoretical model and observed outcomes. Finally, Chapter 5 provides summary, conclusions and implications of the dissertation.

As a means of more formal introduction, the remainder of this section describes the objective, methodology, results, implications and contributions of each of the studies that constitute Chapter 2, Chapter 3 and Chapter 4 of this dissertation, which explores the governance structure, and decision-making of PCROs.

1.3.2. Research Allocation Decision-Making in PCROs

Chapter 2 of this doctoral dissertation provides a comprehensive examination of how some of the key PCROs in Australia, the U.S. and Canada make research allocation decisions. The information related to the governance structure and decision-making processes of PCROs was primarily collected through interviews with manager and directors of seventeen organizations including fourteen PCROs, one cooperative (Limagrain) and two publicly funded organizations (Agriculture Development Fund (ADF) and Genome Prairie). The "redundancy point" (Lincoln & Guba, 1985) and "theoretical saturation" (Eisenhardt, 1989) were taken into consideration to choose the number of PCROs, where widespread consistency in the responses limited the expected gain from additional interviews. In addition, some of information about the organizations was obtained from the websites of these entities. Each interview addresses: objective, missions, constraints, governance structure, decision-making stages, criteria used to allocate resources and so on. This part of the study focuses on grain-based PCROs with varying checkoff revenues, mechanisms, different intellectual property rights, and range of scale and scope.

From analyzing the interviews, a great deal of similarity across PCROs governance structures was observed. Some of the findings of this part of the research are as follows:

1) by definition the PCROs are NP organizations. NP organization is defined as an entity that does not lawfully distribute its profit to the stakeholders (i.e. non-distribution restriction)

(Hansmann 1980; Weisbrod 1988). The PCROs have the same characteristic where farmers, as the patrons and beneficiaries of the PCROs, do not have direct right over the revenues or outcomes of the investments proportional to their contributions.

2) The analyses of PCROs functions examined in the study suggest that, based on Hansmann (1980)'s classification, the PCROs are primarily categorized as a mix of donative-mutual and donative-entrepreneurial. This is because the farmers' contributions are the primary source of funding in the PCROs and farmers and professional managers are in charge of these organizations' decision-making. Besides, it was observed that a considerable number of PCROs are involved in commercial activities as well.

3) One can distinguish between five stages of decision-making in the research funding decision of PCROs: i) determination of priorities, ii) request for proposals (RFP), iii) review and ranking of proposals, iv) measuring performance and v) finally collecting information about growers' feedbacks and their research interests.

4) PCROs use different methods to rank the projects. However, in most of the PCROs sampled, projects are reviewed and ranked based on scoring methods. Organizations then rely on research committees and the boards of directors to choose amongst the projects.

5) PCROs do not tend to separate between management and oversight tasks. In other words, the directors of these organizations are highly involved in most of the stages explained above.

The study presented in the Chapter 2 makes several contributions: 1) it fills a gap in the literature related to the governance of PCROs by providing an extensive examination of these organizations decision-making process and governance structures. 2) it provides a theoretical explanation about the nature of PCROs' functions in the context of NP organizations literature, 3) the study also reveals an apparent anomaly in the governance of PCROs by showing that the oversight and management tasks are not separated in these producer-led entities, 4) finally this study provides the best management practices that can be used by PCROs to improve their governance and decision-making.

1.3.3. Who Governs PCROs in the Agricultural Sector and Why?

Chapter 3 develops an agency-based theoretical model of task assignment in PCROs. As explained in section 1.3.2, PCROs do not tend to separate management decisions and oversight. In fact, during the interviews, it became clear that with one exception, boards of directors are

involved in both the management decisions and oversight of those decisions. The theoretical model is developed to explain why PCROs tend to assign a substantial portion of managerial decisions to their boards of directors.

The agency-based theoretical model builds on the task delegation literature. Under the moral hazard problem, Holmstrom and Milgrom (1991) discuss that the principle will delegate a job to only one agent, if it is difficult to measure the contribution of each agent separately. PCROs have long gestation periods for their research, making output measurement very difficult and subject to uncertainty, which makes the task of incentivizing managers based on output costly and difficult. This is because rewarding the manager based on the highly volatile measure of the investments' outcome (i.e. measuring an effect that will be realized after several years) is not an optimal tool to motivate the management team. Therefore, the contract rewarding the manager should be based on another indication of the management team's efforts. In this case, Sappington (1991) suggests the organizations could use a measure of the manager's input. However, use of such a measure is possible only if there is a third party observing the management efforts exerted. Hence, it is suggested that the board's involvement in the decision-making process is necessary to incentivize the managers of PCROs. On the other hand incentivizing managers based on input requires some observation of the decision-making process.

In the model the PCRO must delegate the share of decision-making power to the manager and the board of directors, with the objective of maximizing return to producers. This choice is determined by several factors, including the characteristics of the board of directors, the relative knowledge levels of the manager and board members, and the ability to incentivize the effort of the manager based on imperfectly measured output or decision-making input. Managers tend to be imperfectly incentivized, because output can only be measured with long lags and uncertainty, and input measurement requires monitoring. Board members, on the other hand, can be less knowledgeable, but can be motivated by vested interest in outcomes, altruism and learning opportunities.

In the case of an output-based bonus, the results of the model suggest the PCRO decides to assign the task to either the almost perfectly incentivized manager or the board of directors, depending on their relative effectiveness. A separation of decision-making and oversight would exist in this case, over a range of plausible parameter values. However, when the manager's

reward is based on his/her input, given similar characteristics of the board and the manager, the shared decision is more likely to be the norm if the board is not significantly altruistic. However, if the board is highly altruistic, the PCRO decides to share the decision-making if the manager's input qualities, including his knowledge level or cost of exerting efforts, are judged to be superior. In these situations, the board of directors will generally also participate in order to both incentivize managerial effort and help the PCRO to reach its objectives.

The findings of the Chapter 3 of this dissertation imply that there is a rationale behind the apparent anomaly observed in the governance structure of PCROs. The governance structure of PCROs can be explained by the presence of an agency problem related to the short-term measurement of output. Hence, the PCROs could reconsider their contracts with managers to provide more effective incentives for parties involved in decision-making.

In addition, the study found that board members' altruism, learning capacity and knowledge levels are critical to the success of PCROs. This implies that resources spent on recruitment, training and retention will play long-term dividends for producers supporting the PCROs.

The contributions of the research results presented in the third chapter of this dissertation are as follow: 1) it provides a theoretical explanation about the lack of separation between oversight and management in the PCROs. It also expands the theory developed by Hansmann (1980) regarding the presence of patrons in controlling of an organization, 2) it contributes to the task delegation literature by incorporating the impact of long investment horizons on the task assignments, the output versus inputs performance measures and collective incentives. 3) the study also provides basis for further investigations of NP and FP organizations in which the return on investments are accompanied with great deal of delay and uncertainty.

1.3.4. Survey of directors of Saskatchewan Grain PCROs

Chapter 4 of this dissertation examines two hypotheses derived from the theoretical model presented in Chapter 3. In fact, due to the shared decision-making observed during the course of interviews, a theoretical model is developed in Chapter 3 allowing us to discuss the conditions explaining the task assignment practice of PCROs. The hypotheses below are about the conditions that would lead to these outcomes.

The first hypothesis is: *PCROs that use shared decision-making may not have frictionless measures of either managerial input or PCRO's output.* The second hypothesis is: *PCROs that*

use shared decision-making may either have highly altruistic directors perceiving the managers to be more knowledgeable than the board members or their directors are not altruistic.

Data from a follow-up survey of the directors of all (eight) grain PCROs within the Canadian province of Saskatchewan was used to examine these hypotheses. Twenty-two out of the fifty-two of the board members from these grain PCROs took part in the survey. The survey questionnaire contained seventy-four semi-structured questions capturing information about the directors' experiences both as farmers and board members of PCROs. The survey includes questions about the experiences of the participants both as farmers and directors.

In the case of the first hypothesis, the directors' stated the returns on investments are not considered as a basis for the managers' compensation and indicated that the manager's contribution to the PCRO's performance is difficult to measure. In addition, the respondents revealed that directors follow different methods to evaluate the managers' inputs. These differences in evaluation approaches imply the input performance measures are not frictionless. In the case of the second hypothesis, the responses revealed that the directors are highly altruistic directors, while most of board members surveyed believed the managers are more knowledgeable than the directors. Therefore, this hypothesis is also consistent with real world task assignment in Saskatchewan PCROs. To sum up, these results are consistent with the theoretical model presented in Chapter 3 explaining the behavior of PCROs and their task assignment practices, and therefore provide some empirical support for the model.

1.3.5. The Concluding Chapter

Chapter 5 briefly summarizes the dissertation, presents conclusions, and discusses implications of the research.

Chapter 2: Review of decision-making processes and governance structures of key PCROs in Australia, the U.S. and Canada

2.1 Introduction

In Canada, Australia, the U.S., New Zealand and a number of other countries a range of public and producer controlled research organizations (PCROs) in the agricultural sector are charged with the challenging task of investing millions of dollars in R&D and market promotion projects. The organizations investigated in this dissertation are different than agricultural cooperatives and agricultural producers associations in which farmers are present as directors. PCROs are different than cooperatives because as we explain later, PCROs have the non-distribution constraint and considered as NP organizations. The PCROs do not have any residual claimants, as the shares are not defined in these entities. However, cooperatives distribute their profits amongst their members (Hansmann 1980). The PCROs should be also distinguished from the agricultural producer associations that are NP organizations by nature. This is because the PCOs are typically granted taxing power by governments while agricultural producer associations, as NP organizations, do not have such a power. Furthermore, the PCROs are specially tasked with investing farmers' checkoff in agricultural R&D and promotion projects while the tasks of agricultural cooperatives and agricultural producer associations include a wide range of activities including marketing, advocacy, distribution and so on.

The PCROs main funding source is the levies paid by farmers. Every year, farmers have to pay a proportion of their sale or the monetary value of the crop(s) produced to these organizations. Investments made by PCROs are primarily related to agricultural innovation and market promotion projects for the crops the farmers pay levies on. Because these organizations are usually too small to have their own research facilities, PCROs have significant collaboration with universities or other research entities.

The decision-making required to allocate research money effectively is complex. The PCROs are tasked with the challenge of investing to increase the productivity of farming for a broad spectrum of members, with different needs and research interests. These producer-led

organizations are also increasingly operating in an environment where both private firms and the public sector are making investments. This implies that PCROs must consider how to create industry synergy through research investment.

Despite their generally strong record of past performance measured by many benefit/cost studies (Williams, 1999, Alston, Chan-Kang, Marra, Pardey, & Wyatt, 2000; Alston, James, & Pardey, 2011; Gray & Scott, 2003; Hurley, Pardey, Rao, & Andrade, 2016), the governance structure and methodologies used to allocate funds in the PCROs have not been extensively examined. While the choice of the best R&D projects is economically important, very little is known about the nature of producer controlled research organizations, who makes the investment decisions in them and how.

This chapter has two purposes. Firstly, it reviews and compares the governance structures and the decision-making processes of some of the key PCROs across Australia, the U.S. and Canada. Secondly, it develops best practices for the PCROs and other types of organizations.

In fact, this part of the study is the first piece of the methodology trying to build theory from case studies (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Siggelkow, 2007). This chapter reports the analyses of a series of interviews and then describes the differences and similarities in PCROs governance structures and decision-making process. In addition, this chapter highlights some of the governance features of PCROs in the context of NP organizations and agency theory literature.

The information presented in this chapter is collected through interviews and by reviews of the websites of the entities in the sample. The interviews included semi-structured questions. Interviews collected information about the process of investment decision-making and the agents who are in charge of making decisions. The survey covered a range of PCROs with varying levels of checkoff revenues and covering different types of grains. Livestock PCROs were excluded because of the differences in the nature of innovation in livestock and grain industries. It should be noted that the “redundancy point” (Lincoln & Guba, 1985) and “theoretical saturation”¹ (Eisenhardt, 1989) were taken into consideration regarding the number of PCROs in the sample.

¹. The “redundancy point” and “theoretical saturation” are the rule of thumbs in conducting interviews. In both cases, the researcher gets to a point after which more interviews do not provide new information and insights.

The analyses of interviews reflect the characteristics of these entities in their decision-making. In addition, the interviews revealed that in contrast to the existing theories and several studies, the board of directors in all PCROs, except Australia's Grain Research and Development Corporation (GRDC), are involved both in management and oversight tasks in their organizations. In the GRDC the board of directors' roles are more in the form of oversight. However, the producers are involved in management of these organizations where the priorities are determined by regional panels.

Section 2.2 of this chapter, provides background about the PCROs and then reviews some of the characteristics of the PCROs in our sample. Section 2.3, discusses information about the process of data collection and interviews structures. Section 2.4 reviews and compares the governance structure of the PCROs in the sample. The decision-making processes of PCROs are described in Section 2.5. Discussion regarding analyses of the interviews is presented in Section 2.6 and finally Section 2.7 provides the concluding remarks.

2.2. Review of the PCROs Characteristics

This section reviews the features of the PCROs and their importance in agricultural R&D by review of the literature and then describes some of the characteristics of the PCROs in our sample.

2.2.1. The Impact of PCROs on the Agricultural sector

Studies indicate governments and the private sector have begun to decrease their funding of agricultural research. However, the role of industry groups such as PCROs have increased in research funding (Alston et al., 2012, 1998). There are several studies indicating PCROs' investments have had significant impacts on agricultural innovation and the welfare of producers and consumers (Alston et al., 2000, 2011; Gray & Scott, 2003; Hurley et al., 2016; Williams, 1999). The studies also show that PCROs improve the efficiency of resource allocation, and decision-making process (Alston et al., 2004; Kangasnime, 2002). Because the board of directors of PCROs are farmers, they can provide proper investment guides to respond to farmers' research interests (Klerkx & Leeuwis, 2008; Röling et al., 2004). On the other hand, the PCROs are considered a new player in the national innovation system of a country. The presence of these organizations changes the dynamics of the system because their contributions result in

new connections and knowledge flows affecting other parties' behavior in the system (Klerkx & Leeuwis, 2008).

However, the increasing role of PCROs may redirect the funds toward the projects benefiting the industry's stakeholders rather than society as a whole, especially in cases where the PCROs and society have different incentives in funding agricultural research. These differences stem from the elasticity of supply and demand and the impact of innovation on the supply of the product. (Alston et al., 2003, 2004). In addition, the increasing role of PCROs in research funding could worsen the market and governments failures by crowding out other parties interested in research investment (Alston et al., 2003, 2004).

2.2.2. The Characteristics of PCROs in our Sample

Table 2.1 indicates the revenues and the shares of R&D projects of the organizations in the sample. In total, the organizations sampled earned more than C\$465 million in 2015 or 2016. The organizations rely primarily on farmers' contributions.

Table 2.1. The Characteristics of the Organizations Investigated in the Sample

Organization	Grain(s)	Year Established	Gross Revenue and the source(s) (Million CAD) in 2015 or 2016	Approximate proportion of revenue spent on research and development
Manitoba Canola Growers (MCG)	Canola	1996	2.67 growers' levies	20%
Saskatchewan Canola Development Commission (SCDC)	Canola	1991	5.2 growers' levies	41%
Iowa Corn Promotion Board (ICPB)	Corn	1976	24.4 growers' levies and its patents 'licensing fees	21%
Saskatchewan Flax Development Commission (SFDC)	Flax	1996	1.4 growers' levies	44%
Western Grain Research Foundation (WGRF)	Multi-grain	1981	28.8 growers' levies, endowment fund and royalties.	68%
Grain Research and Development Corporations (GRDC)	Multi-grains	1990	201.24 growers' levies, Australian government matching and royalties.	97.5%
Agriculture Development Fund (ADF)	Multi-grains	1984	7.7 ADF is a government funded organization.	-
Grain Farmers of Ontario (GFO)	Multi-grains	2010	11.5 growers' levies, license fees and sales of the research results.	14%
Saskatchewan Pulse growers (SPG)	Pulses (multi-grains)	1984	19.1 growers' levies, variety commercialization and others.	61%
United Soybean Board (USB)	Soybean	1991	133.5 growers' levies	62%
Iowa Soybean Checkoff Program (ISCP)	Soybean	1964	14.7 growers' levies, equipment lease and sale of the researches results.	-
Saskatchewan Wheat Development Commission (SWDC)	Wheat	2013	5.0 growers' levies	90%
Kansas Wheat Commission (KWC)	Wheat	1957	5.9 growers' levies, equipment lease, licensing fees and others.	26%
Alberta Wheat Commission (AWDC)	Wheat	2011	6.2 growers' levies	29%
Montana Wheat and Barley Committee (MWBC)	Wheat and Barley	1967	6.0 growers' levies and royalties.	48%

The largest organization in the sample is the Grains Research and Development Corporation (GRDC), with gross revenue of C\$201 million in 2016 and the smallest one is the Saskatchewan Flax Development Commission (SFDC) whose revenue was C\$1.4 million in

2016. United Soybean Board (USB) and Saskatchewan Pulse Growers (SPG) are two other large organizations in the sample.

There is a positive correlation between revenue and percentage of expenditure on R&D investment. For instance GRDC, as the largest organization in the sample, spent more than 97 percent of its revenue on research projects. However, there are other factors determining the share of revenue expenditure on R&D, such as significance of market promotion for the PCROs. For instance, although USB's revenue is considerable, it spends only 62 percent of its revenue on R&D projects because an important part of its budget is allocated to market promotion.

The PCROs in the study have different historical backgrounds. The oldest organization in the sample is the Kansas Wheat Commission (KWC) established in 1957 and the youngest organization is the Saskatchewan Wheat Development Commission (SWDC) founded in 2013. In some cases, such as KWC, SPG and Western Grains Research Foundation (WGRF), farmers first founded the organizations and then they were granted rights by officials to collect levies. In some other cases, such as GRDC and USB, governments had the main roles in establishing the entities. Some of the organizations such as Alberta Wheat Commission (AWC), Grain Farmers of Ontario (GFO) and SWDC were established recently. AWC and GFO are the result of mergers between several other organizations who decided to operate under one umbrella.

2.3. Interview Structure and the Process of Data Collection.

To collect information about the governance structure and decision-making processes of PCROs in the agricultural sector, semi-structured interviews were conducted with managers and directors of 17 organizations including 14 PCROs and one cooperative (Limagrain) and two publicly funded organizations (ADF and Genome Prairie). The interviews were conducted by Seyed Hamzeh Hosseini (PhD Candidate) and Richard Gray (Professor) at the University of Saskatchewan. Each interview included ten semi-structured questions. The questions included categories that are: objective, missions and constraints, governance structure, decision-making process, criteria used to allocate resources, method(s) by which the proposals are solicited, and performance measures.

The PCROs in the sample were selected using two key criteria, checkoff revenue and the commodity. It was important to cover a range of PCROs regarding their checkoff revenues and the types of grains that the PCROs work on.

Except for KWC, Montana Wheat and Barley Committee (MWBC), and GFO, we had face-to-face interviews with the managers or directors of the rest of PCROs in the sample. On average the interviews lasted about one hour. The webpages of the PCROs were also examined to garner an understanding of their financial status, decision-making processes and governance structures.

2.4. The Governance Structure

Analyzing the interviews regarding governance structure specifically focuses on the nature of PCROs activities, their ownership structure, funding sources and the agents who are in charge of making the decisions.

2.4.1 PCROs as NP Organizations

In terms of ownership structure, PCROs are non-profit (NP) organizations. A NP organization is defined as an entity that does not lawfully distribute its profit to the stakeholders (i.e. non-distribution restriction) (Hansmann 1980; Weisbrod 1988). PCROs have the same characteristic where farmers, as the patrons and beneficiaries of the PCROs, do not have direct rights over the revenues or outcomes of the investments proportional to their contributions. In these organizations, the research results are more or less available for everyone.

The establishment of agriculture PCROs stems from market and government failures in providing sufficient and efficient investments in agricultural R&D (Alston et al., 2012). In the literature, the formation of NP organizations also initiates from the three failures that are: government failure, market failure and contract failure (Ben-Ner and Van Hoomissen 1991; Hansmann 1980; Weisbrod 1972; Weisbrod 1988).

Market Failure

Demand-side stakeholders usually form NP enterprises. The demand-side stakeholders form the organizations because they are not satisfied with the quantity or quality of goods supplied by market or government (Ben-Ner & Van Hoomissen, 1991; Weisbrod, 1972). Similarly, in many cases, farmers themselves lobbied for establishment of PCROs (Alston et al., 2012).

Government Failure

The NP organizations may also have advantages over governments because the governments could fail to respond to all parties' interests in a country (Weisbrod, 1972). This

government failure stems from the fact that it has to finance the provision of public goods with taxes. In the case of crop research, the very high benefit/cost ratio and internal rate of return suggests there is a chronic failure to invest enough in agricultural research. However, governments have a tendency to cover the median or mean voters' preferences. The use of median or mean voters' preferences still keep a considerable part of the society unsatisfied because the government will not be able to equate the marginal tax and marginal benefit of public goods consumption for everyone.

One of the reactions of non-satisfied consumers in this case is establishing organizations providing the demanded collective goods for non-median voters. In other words, the presence of NP sector is an optimal reaction (as the second-best option) to provide collective goods for under-satisfied individuals. The NP sector in this context complements with both the government and private sector in the provision of public or collective goods (Weisbrod, 1972).

Contract Failure

Due to the market conditions, or the nature of some products and services, there are situations in which consumers cannot properly evaluate the quantity or quality of goods and services supplied by the market. Therefore, the contracts between consumers and suppliers about the provision of demanded goods may not be enforced appropriately (Hansmann, 1980). In this setting, NP organizations can be considered as an alternative for other sources of public or collective goods provision.

The superiority of NP enterprises in comparison with for-profit (FP) organizations is related to the non-distribution constraint. In the presence of a non-distribution constraint NP organizations do not strictly look for maximizing returns. Thus, they are less likely to show shirking behaviors in provision of high quality goods and services. (Ben-Ner and Van Hoomissen 1991; Easley and O'Hara 1983; Hansmann 1980; Weisbrod 1972; Weisbrod 1988).

PCROs in Presence of Government, Market and Contract Failures

The establishment of PCROs is also connected to government, market and contract failures. Studies indicate governments have begun to decrease their funding of agricultural research while the results of benefit/cost analyses imply that investment in agricultural research have a considerable rate of return. In fact, because of the high rates of return one could expect that governments should increase their contributions in agricultural research; however, the opposite trend has been observed (Alston et al., 2012, 1998). Governments' insufficient

investments in agricultural research are related to the fact that farmers are not the median voters in many developed countries anymore. In the case of market failure, the private sector considers appropriability factors in its investments behaviors.

In addition in recent years a great number of mergers and acquisitions have been observed in the agricultural sector, such that the few large private firms who controlled a considerable share of the farming input market have gained even more market power (Howard, 2009). This increase in the degree of consolidation is a possible source of contract failure in agricultural research investment. In this situation, as the private firms have market power, they cannot be harmed if they fail to fulfill the terms of the contracts with farmers in provision of inputs.

PCROs' Classification

Hansmann (1980) distinguishes between four types of NP organizations based on financing source and who is in control. According to the categorization, NP organizations can fund their expenses from donations or the sale of their services. These organizations are called donative and commercial respectively. The individuals that are the main source of NP organizations' funding are called "patrons" and according to Hansmann (1980), NP organizations can be controlled by their patrons or by other individuals. The former, controlled by patrons, are classified as "mutual" and the latter as "entrepreneurial" NP organizations. The four types of NP organizations are as follows: donative-mutual (e.g. political clubs, PCROs), donative-entrepreneurial (e.g. CARE, art museums), commercial-mutual (e.g. consumers' unions, country clubs) and commercial-entrepreneurial (e.g. nursing homes, National Geographic Society, community hospitals).

Hansmann (1980) also discusses that the rationale behind the existence of commercial NP organizations is both market and contract failures. The information asymmetry between consumers and producers increases the demands for commercial NP organizations. In this context, the commercial NP organizations usually compete with their FP counterparts, (Hansmann, 1980). Because of the non-distribution constraint, the founders and patrons of NP organizations do not show shirking behaviors in the provision of high quality goods and services (Glaeser & Shleifer, 2001). Therefore, if qualities are non-contractible and consumers value the quality, the demand for NP organization' goods and services will be higher than those of FP firms (Glaeser & Shleifer, 2001; Lakdawalla & Philipson, 2006).

Some NP organizations perform as a combination of the aforementioned categories. For example, universities are funded both by donors and student tuition and both of these groups are somehow involved in the administrations of these entities. Other examples of mixed entities include daycares that are controlled by parents, where the donations and daycare fees are the financial sources used to cover expenses (Hansmann 1980).

The PCROs in the sample are primarily a mix of donative-mutual and donative-entrepreneurial because farmers and professional managers are both in charge of decision-making of these entities. However, in some organizations such as GRDC the weight attached to the managers is higher than the producers.

In addition, WGRF, SPG, GFO, Manitoba Corn Growers (MCG), USB, Iowa Soybean Promotion Board (ISPB), KWC and MWBC are also commercial NP organizations as they earn revenues by supplying their projects results (e.g. new varieties) in the market. GRDC is a mix of a donative-mutual, donative-entrepreneurial and commercial- NP organization, as farmers are not the main decision-makers in this unit. As it is explained later, the hired managers and staff are primarily in charge of making investment decisions in project levels. However, the producers' input is used in the GRDC as one of the sources for determining the "investment themes". In addition, this organization relies on farmers' check-off payments, government's contribution and the sale of its varieties, royalties and other applications of research projects.

WGRF is also a mix of the donative-mutual, donative-entrepreneurial and commercial-entrepreneurial structure. This is because WGRF's board of directors is the directors of other PCROs and farm association organizations in Canada. WGRF's revenue sources are farmers' checkoff payments, government's contribution², royalties, and the sale of its varieties and other applications of research projects.

² Canadian Pacific Railway Company and Canadian National Railway Company have to pay an amount to Canadian Transportation Agency (CTA) when they exceed their Maximum Revenue Entitlement for movement of grain in Western Canada. In turn, the Federal government in Canada pays a part of this money to WGRF in the form of an "endowment fund".

2.4.2. Funding Sources

The main source of funding in all of the PCROs in our sample is a producer levy. Also, GRDC, WGRF and MWBC receive additional funding from the governments of Australia, Canada and the U.S. respectively.

The government of Canada's funding leverages the checkoff money invested in WGRF. In this process, for every producer checkoff dollar spent the government doubles or matches the investments. In addition, WGRF is one of the organizations receiving a part of the endowment funds, such that in the last 10 years the WGRF has received about C\$73 million to invest in crop research projects (WGRF, 2014) .

GRDC primarily relies on levies paid by farmers and the government's matching of these levies. Based on the type of crop produced, the levy rates are 0.99 and 0.693 percent of the gross sale in each year. The government contribution is based on a three-year rolling average, where the Australian government matches the amount collected up to 0.5 percent (GRDC, 2011).

These two organizations also use other sources of income such as licensing fees, and royalties on their research results.

Some of the PCROs will return the producer checkoff received if the farmer requests a refund. Based on the results of our interviews, the refund rates in all organizations are usually below 10 percent. In addition, some of the organizations such as SPG, GRDC and USB do not refund the levies collected.

2.4.3. Board of Directors

In most of the organizations, the directors are elected or appointed based on their local attachment or crop districts. In the case of Saskatchewan PCROs, regional attachment does not play any role in the determination of board members directly. However, regional attachment may affect the election results if a director is in a region in which the number of voters is proportionally more than other areas. In the case of regionally elected or appointed boards, it seems that the decisions made by PCROs could be biased toward areas with more board members.

Government officials or other farming organizations appoint the directors of GRDC, USB, WGRF and MWBC. In the case of USB, GRDC and MWBC, farming organizations nominate candidates to the government officials responsible for appointing board members. The

government officials select directors amongst the nominees. In these cases, the appointed directors are accountable to both farmers and government for their actions. In the rest of the PCROs in our sample, farmers elect the directors.

The directors of USB are recommended by the states-level beneficiaries to the federal government for appointment on the USB board. There are 73 directors involved in USB decision-making. The number of directors from each state is directly associated with the level of soybean production in that jurisdiction.

Similarly, in the GRDC, the boards are appointed by the Australian government, based on the directors' resumes and recommendations of growers and other industry stakeholders. However, the involvement of the GRDC board is limited to oversight with little direct involvement in the decision-making relative to the other PCROs in our sample. WGRF is a membership-based organization and its board of directors represents eighteen PCROs or associations as the members of this organization.

2.5. Decision-Making Process

The interviews showed there are five stages of decision-making in more or less all of PCROs: 1) determination of priorities, 2) request for proposals (RFP), 3) review and ranking of proposals, 4) performance measures and 5) collecting information about growers' feedback and their interest in research. The detailed information about these stages is presented in Appendix A, however the following section will outline the key points about the five stages of decision-making.

Figure 2.1 indicates a typical decision-making process of the PCROs we interviewed. As is shown in this figure, the process is essentially a cycle, where first the board based on the industry needs and research interests determines the priorities. After the investment decisions are made in many organizations, farmers' feedback about the effect of investments are collected. The information gathered in this section could influence future decisions regarding the investment properties.



Figure 2.1. The Typical Decision-Making Process of PCROs in The Sample

2.5.1 Determination of Priorities

The interviews revealed that one or more than one agent contributed to the determination of the investment priorities. These sources are directors, surveys of producers, scientists' recommendations, the research staff of the organizations and governments' priorities. However, in many cases, the directors are the main agents identifying the priorities.

Figure 2.2 illustrates the general process of determining priorities in the POCs. The main difference between the organizations is related to the weight of each source in the determination of priorities and strategies.

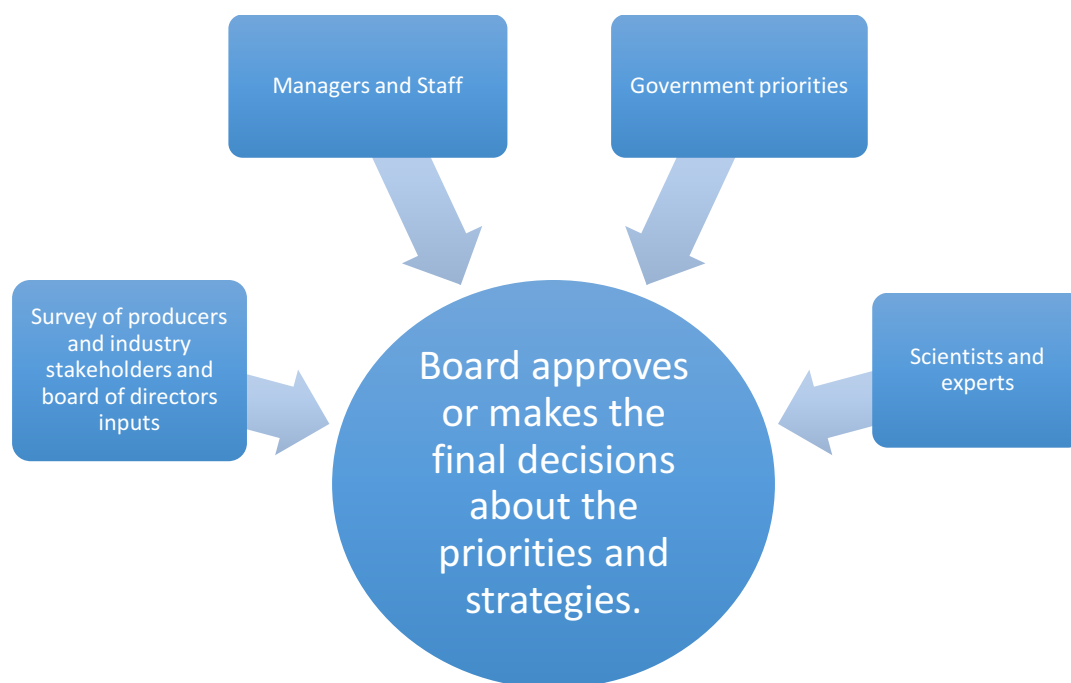


Figure 2.2. The process of determining PCROs' investment priorities and strategies

In the case of GRDC, their board of directors is restricted to a role of oversight and approves the priorities that are recommended by the National Panel but is not directly involved in the project identification process. The National Panel in turn consolidates input from the regional panels. The regional panels include growers, agribusinesses, experts and staff of three regions in Australia. The regional panels collect information about regional and national issues through communication with growers, industry representatives, Regional Cropping Solution Networks (RCSNs) and Growers Solutions Groups (GSGs).

Notably, RCSNs and GSGs are new entities, empowered to make contributions in governance and decision-making of the GRDC. The members of RCSNs are local farmers, agribusiness representatives and local scientists. RCSNs represent local needs and interest to the higher levels of decision-making in the GRDC. In fact, RCSNs were established to provide information to the GRDC regarding problems and priorities in their regions. The members of RCSNs meet on a regular basis to discuss the main issues and priorities for R&D investments. RCSNs also have a small research budget they can directly use to address more immediate local issues.

RCSNs working with regional panels play an important role in determining priorities. There are nine RCSNs in Southern and Western Australia. The southern region is divided into four zones, based upon the amount of precipitation: high, medium and low rainfall zones and an irrigation zone. The western region is divided into five “port zones” including Geraldton, Kwinana West, Kwinana East, Esperance and Albany. For instance, 36 priorities were identified in Southern RCSNs during 2013-14, resulting in the GRDC making new investments in 17 areas. Issues are also addressed by increasing investments in ongoing projects.

In addition, GSGs are also a new part of the GRDC governance. These groups directly engage growers and agribusiness and experts to provide solutions for local problems. The GRDC uses the information provided by GSGs when it sets one to three years’ priorities in research. The GSGs also have the ability to support research related to the local problems they represent.

Using the inputs from different sources as explained above, regional panel members and GRDC managers at a national level meet in July or August for discussions about priorities and investment gaps. Based on the analysis of information, as well as Australian government investments priorities, GRDC makes decisions about budget allocations among investment themes and investment priorities.

After discussions regarding GRDC budget allocations amongst investment themes, managers provide proposals for targeted R&D investments. Finally, the National Panel made up of the chairs of Region Panels and GRDC research managers provides recommendations to the board with a final resource allocation plan. The scale of the GRDC allows this organization to separate oversight and management decisions, while proactively seeking producer and broader industry input at the local and regional level.

By comparison, the USB, with its statutory board of over 70 members, uses a matrix format in the process of decision-making. In this matrix there are four target areas; these are: domestic opportunities, international opportunities, supply and communication. There are also four action teams: meal, oil, freedom of operation and consumer focus. These action teams are based on strategic objectives of USB, these are: increasing the values of soybean meal, enhancing the values of soybean oil, facilitating the freedom of operation for farmers and finally increasing the quality of soybean products to increase the demand for U.S. soybean. So for each target area there are four strategic objectives to follow and action teams are in charge of pursuing these targets.

In the context of the matrix, board members are first assigned to action teams and then within each action team they are divided into smaller groups. These small groups contain three or four directors, assigned to the target areas of their action team. In other words, there are 16 groups each including three or four directors and each of these small groups becomes an action team for target areas. For instance, three or four members of the board of directors are in charge of soybean oil in the case of production research (supply).

In this system, the resource allocation decisions for each target area are made with consideration of the issues of similar action teams in the other areas. It means the action teams are aware of issues in all of the target areas and they interactively make decisions.

The issues addressed in the matrix components are used as the preliminary resource for allocation decisions. However, primary contractors (Smithbucklin, USSEC and Osborn Barr)³ provide program briefs related to their area, in which they discuss the constraints, role of USB, and issues related to decisions made. In the next step, the directors and staff related to each target area meet to discuss the programs in more detail. In this stage, external experts might also be invited to discuss the possible outcomes and constraints of these programs. Based on the projection of checkoff revenues and other related information, the board makes decisions about the allocation of available resources. These individual decisions become the USB's budget. As mandated in the federal marketing plan that established the USB, the budget is then reviewed by Agriculture Marketing System (AMS) of United State Department of Agriculture (USDA) and if AMS approves the budget, the USB will proceed with its plans.

2.5.2. Request for Proposal (RFP)

The RFP stage is an important part of decision-making as it is the main way to identify possible investment opportunities. Based on interviews a number of key points became evident. Most of the organizations in the sample make request for proposals directly or in partnership with other organizations. In addition, there are cases in which the PCROs directly negotiate specific projects with the researchers. In the case of GRDC, the researchers have to give up their

³ By law, USB can only spend up to 3% of its revenue on administration costs. To deal with this constraint, this organization has defined three projects to outsource an important part of its administrative activities. These projects are related to production research (supply), market development and communication. These projects are contracted to Smithbucklin, United Soybean Export Council (USSEC) and Osborn Barr respectively.

rights over the ideas presented in their proposals. If the GRDC likes the idea they use them to draft a detailed RFP that all competitors can also bid on, before deciding who to fund.

In the RFP stage, many of the organizations use shorter letters of intent (LOIs) to filter the ideas. LOIs are specially used if an organization receives a considerable number of proposals. LOIs are also used if there are possibilities of overlapping investments between organizations with similar objectives.

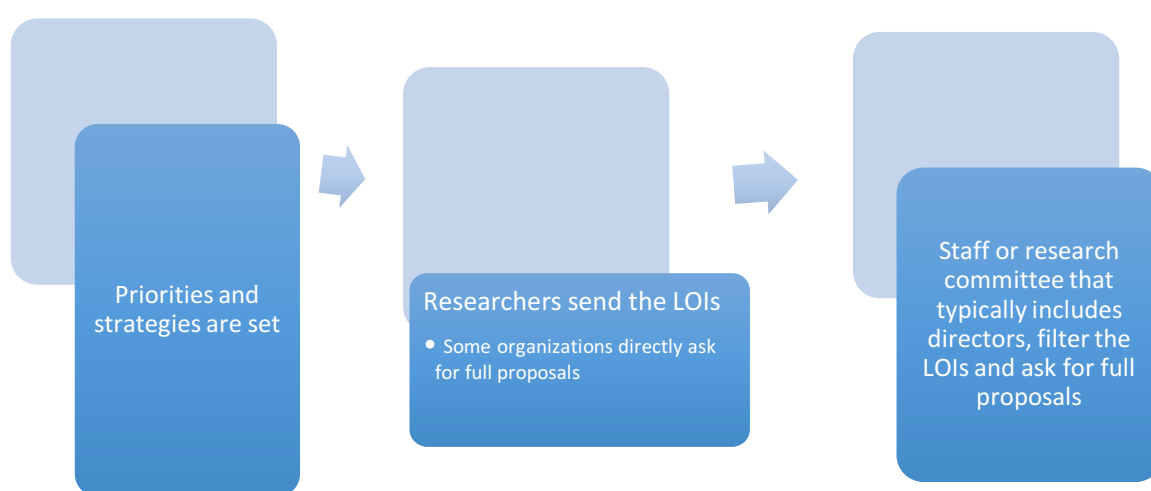


Figure 2.3. The request for proposals stage in the decision-making process of PCROs

The LOIs are usually evaluated by a research committee or similar bodies, the majority of the members of these bodies are also organization board members. If the research committees accept an idea, then it invites full proposals. In many cases a considerable proportion of LOIs are approved by the PCROs and invited for subsequent proposal development.

The board of directors has two primary roles in the RFP stage. First, it determines the priorities that shape the RFPs and then a fraction of the board members that form the majority of research committee members make final decisions about the possible investments.

The sample PCROs made requests for different types of information in the call for proposals. However, all of the PCROs in the sample ask the researchers to provide information

about the benefits of the research results for producers. In many cases, the organizations do not ask for specific measures of these benefits.

In the case of Saskatchewan, the Agriculture Development Fund (ADF) plays an important role in this process for almost all organizations. In fact, in each year dozens of LOIs are sent to ADF and then distribute the related letters to the PCROs of Saskatchewan. In this process PCROs and ADF extensively interact with each other to choose amongst the LOIs.

Among the PCROs sampled, the Iowa Corn Promotion Board (ICPB) does not have RFP stage. In this organization the board of directors, with the help of staff, identify the main issues in corn production in Iowa and US. After that, the ICPB decides about types of projects that should be defined and funded.

2.5.3. Review and Ranking of Proposals

Review and ranking of proposals are also important parts of the decision-making process. Appendix A provides detail information about this process of the PCROs in the sample. The board of directors in all of the organizations, except GRDC, play crucial roles in reviewing and funding proposals. Typically, a subset of directors that are the leading members of the research committee reviews the proposals. In this committee, proposals are reviewed and ranked based on the pertinent criteria. Also the research committee provides a report for the board of directors by which it recommends whether a proposal should be accepted for funding or not. Finally, the board of directors makes the final decisions about projects PCROs should fund.

In different organizations, applicants are supposed to provide different kinds of information used for ranking of the projects. In this process, the research committee uses the information to rank the proposals against a set of predefined criteria.

Some of the main criteria used by research committees to rank the proposals are: alignment with strategic plans, consistency with substantial ongoing investment programs, benefits to farmers, scientific merits, value for money, measures of possible outcomes and the probability of success or failure.

One of the main factors increasing the possibility of funding for a proposal is the presence of other parties to co-fund that proposal. For instance, more than 50 percent of GRDC investments are in the form of co-funding with other organizations. Similarly, in Saskatchewan and many other regions there are the same tendencies amongst the PCROs for co-funding.

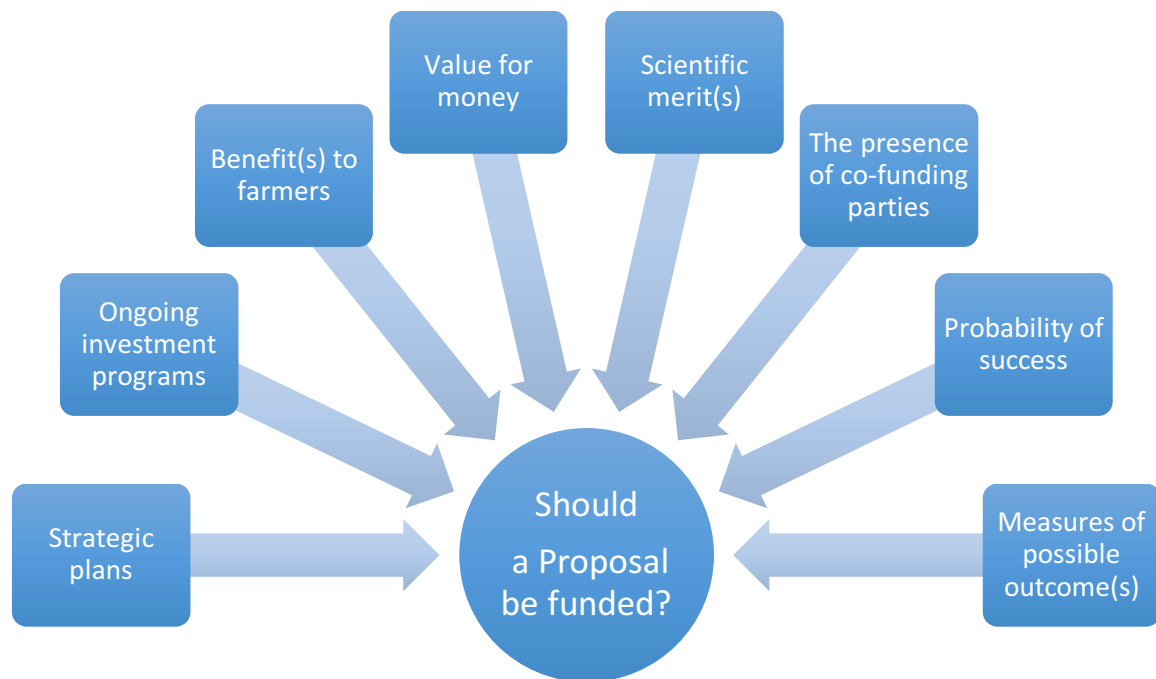


Figure 2.4. The review and ranking process

Different methods are used to rank the projects. Based on the interviews it is clear that to varying extent GRDC, USB, WGRF, ISCP, ICPB and KWC all make their decisions with the aid of additive ranking or scoring methods. In some cases minimum scores are used to eliminate unsuitable projects, in other cases the scoring is used to rank all of the projects.

An exception to the additive scoring system is the economic-based ranking method used by ICPB. After the identification of priorities, ICPB uses industry consultants to elaborate on the technical issues related to the priorities. Using the priorities and consulting with external experts, ICPB defines a handful of projects. In the next step ICPB, with the help of consultants, conducts a preliminary market analysis for the defined projects including market opportunities, volume, competition and possible role of the organization. After that ICPB decides who would be the best possible research partners. The main criteria used by ICPB to determine which projects to fund are market volume, cost of production and patentability of the projects.

The remainder of the organizations that are not using a scoring method typically rely on the research committee, external advisors or board of directors to choose amongst the projects based on a number of factors, where the share of each factor is not explicitly defined.

2.5.4. Performance Measures

All of the organizations in the sample measure the performance of individual projects by use of interim and final reports. More than half of the organizations interviewed do not measure their general performance.

GRDC uses several methods to evaluate performance. For some of the main programs GRDC commissions external experts to assess the ex-post economic impact of investments in project levels. Also, GRDC conducts surveys amongst farmers and research partners. Farmer surveys are primarily used to determine whether the studies conducted were of benefit to growers or not. The research partner surveys are carried out to provide information about the effectiveness of GRDC's relationships with its partners, and they are used to solve possible problems in GRDC's operations. GRDC also provides annual operational plans in which it provides measures of its performances in achieving the expected outcomes of investment themes and strategies. These measures are based on several reports and surveys provided on a regular basis.

By legislation, USB has to provide ex-post benefit cost analysis of its total investments. ISCP and ICPB use key performance measures indicators to evaluate their performances towards their objectives. Montana State University provides reports that include information about the performance of past and present projects funded by MWBC. These reports are related to investments in the cropping system, variety development and disease and weed management.

2.5.5. Mechanism to Collect Farmers' Feedback and Research Interests

In most of the organizations, board of directors' opinions as industry representatives and interaction with other organizations are the two main channels used for collecting information about farmers' needs and research interests. Some of the organizations such as GRDC, ADF and GFO conduct surveys to gather information from growers, advisors or scientists about the demand for new studies. Some of the organizations such as USB and ISCP send their employees in the field to collect information.

2.6. Discussion

As it is indicated so far, with the exception of the GRDC the board of directors of PCROs are involved in both oversight and management tasks of these entities. However, this observation is in contrast with most of the theories and empirical studies focusing on the governance structure of NP and FP organizations (Brown & Guo, 2010; Fama & Jensen, 1983; LeRoux & Langer, 2016; Miller-Millesen, 2003).

The roles of directors in NP organizations have been investigated extensively in the literature. There are three different types of theories explaining the roles of board of directors in NP organizations, they are “agency theory”, “resource dependency theory” and “instructional theory” (Miller-Millesen, 2003; Brown, 2005) .

Agency theory suggests that management and oversight are supposed to be separated in NP organizations even if they do not have residual claimants (Fama & Jensen, 1983). Based on agency theory’s implication, the role of board of directors in NP organizations is primarily limited to monitoring of managerial decisions and aligning organizational activities toward its objectives.

Resource dependency theory stresses on the role of board of directors in reducing the uncertainty of operations in NP organizations by providing different types of information and resources (Fligstein & Feeland, 1995). Under resource dependency theory, the role of board of directors is more about providing resources for organizations such as advice, legitimacy, links to other organizations and “strategic directions” (Cornforth, 2001; Miller-Millesen, 2003; Brown, 2005). One of the main resources brought to the NP organizations by the board is strategic directions (Bradshaw, Murray, & Wolpin, 1992; Stone & Cutcher-Gershenfeld, 2001).

Finally, institutional theory focuses on the rules and norms defining the behaviors and roles of board of directors (Zucker, 1987). Institutional theory predicts that organizations of similar type or environment (e.g. NP organization, PCROs, etc.) become isomorphic by adopting common rules and norms (DiMaggio & Powell, 1983). Therefore, one could expect that the role of the board of directors in NP organizations may not be related to their characteristics and it is the results of the institutional arrangements.

Although resource dependency theory and institutional theory could provide some useful insights about the involvement of the PCROs’ directors, it is suggested that the role of directors in these entities could be explained by agency theory. Especially in the context of resource

dependency theory, the directors are supposed to provide resources facilitating the managers' decision-making. In other words, the resource dependency theory assumes that the directors and the management teams are in charge of two different tasks. However, in the case of PCROs, the directors and the managers are both involved in the fulfilling of one task that is making investment decisions.

Furthermore, the "resource dependency theory" simply assumes that the board members do not have any personal agenda. In other words, the only factors motivating the board member to exert efforts is the success of the organizations, while in "agency theory" one can incorporate personal and collective incentives into the behavior of the board of directors of NP organization.

Now the question is why PCROs do not hire a manager with a potential for high quality of decision-making and thus invest farmers' money properly. Hansmann (1980) suggests that the patrons are willing to take over the control of the NP organizations because they will be able to control and protect their donations more efficiently. However, it is discussed that as the costs of controlling the organizations relative to the marginal benefit of involvement increases, the patrons will be less interested in controlling the NP organizations. (Ben-Ner and Van Hoomissen 1991; Ben-Ner 1994; Hansmann 1980). Therefore, the directors of PCROs are expected to be present in the process of decision-making to 1) make sure the research money is spent properly and 2) they gain from their involvement in the process. Thus, the involvement of directors suggests that the managers of PCROs are not motivated to exert efforts maximizing return on investments and the directors have to be present. In addition, the directors also have incentives to participate in the management of these organizations.

The delgation of the tasks among the agents of an entity have been investigated in task delgation literature. Under the moral hazard problem, Holmstrom and Milgrom (1991) discuss that the priniciple will delgate a job to only one agent if it is difficult to measure the contribution of each agent separately. The reason behind this choice is that agents will not have motivation to exert optimal efforts if they cannot be incentivized based on their individual contributions. On the other hand, if the principal can observe the inputs of each party in the team production, she hires two agents to perform the tasks (Itoh, 1994).

In general, in the context of task delegation literature, the important factor determining the choice of task delegation is the incentives for exerting efforts. Therefore, if the evaluation of output is difficult in a firm, the contracts incentivizing the agents have to be designed so to

motivate optimal efforts. (Glaeser & Shleifer, 2001; Hallock, 2002; Handy & Katz, 1998; Murphy, 1999).

In a comprehensive study of U.S. public agricultural research investments, Alston et al. (2000) showed public agricultural research has measurable impacts 40 years after the investment was made, and the peak impact occurs 25 years after the investment was made. With these long timelines, delegating the whole decision-making tasks to the manager is a source of moral hazard problem. This is because rewarding the manager based on the highly volatile measure of the investments' outcome (i.e. measuring an effect that will be realized after several years) is not an optimal tool to motivate the management team. Therefore, the contract rewarding the manager should be based on another indication of management team's efforts. In this case, Sappington (1991) suggests that the organizations could use a measure of the manager's input. However, use of such a measure is possible if there is a third party observing the management efforts exerted. Hence, it is suggested that the board's involvement in the decision-making process is necessary to incentivize the managers of PCROs.

Based on the discussion above, one could discuss that the lack of timely observable outcomes may result in similar governance structure. Dewaelheyns et al. (2009), in the study of nursing homes run by FP, NP and public sectors in Belgium, observed that the level of separation between oversight and management are significantly lower in NP nursing homes when compared with the for profit counterparts, such that the board of directors in the NP nursing homes are highly involved in operational activities. According to the authors the lack of separation in NP nursing home is related to the issue of "micro-monitoring." "Micro-monitoring" refers to the fact that "boards of directors fails to delegate decision powers on daily issues to management and keep decision-making at the level of the supervising bodies instead" (Dewaelheyns et al. 2009, pp 189).

Another case in which the board of directors' involvement is considerable, is related to the venture capitalists (VCs)' involvement in start-up companies. In this case, the performance of start-up companies cannot be measured easily.

Start-ups may have promising ideas, however these ideas are usually documented in patents, thus the realization of revenue in start-ups is accompanied with considerable uncertainty. Therefore, one may suggest that the VCs are likely to look for higher levels of

controls in start-ups especially where the returns on investments are accompanied with great deal of uncertainty.

In this context, Kaplan and Stromberg (2002) show that VCs investments in start-ups give them voting rights, board rights and rights on cash flows. However, if the start-ups have proper performance, the VCs only keep the cash flow rights and give the other rights up. In addition, if the VCs find out that the companies are failing to achieve their goals, they are likely to gain the full control. In other words, the VCs' control over a company' management is negatively associated with the company' performance.

The authors also illustrate that the VCs usually use their voting rights to obtain higher levels of controls in comparison with the founders or entrepreneurs. In fact, the VCs controls are higher than the founding bodies where there is uncertainty concerning the investment results.

The study by Kaplan and Stromberg (2002) also indicates that as the start-ups' performances become more difficult to measure, the managers or founders' compensation by VCs become less sensitive to the performance measures. Especially in the case of companies in which the results might have considerable volatility, the managers' compensation package is more based on "time vesting" payments.

Fried, Bruton and Hisrich (1998) show that in comparison with other directors, the board members representing VCs play more active roles in the board of directors of start-ups. The same results can be found in Rosenstein, Bruno, Bygrave and Taylor (1993) showing that the involvement of directors representing VCs is significantly more than other board members where VCs are the lead investors of the start-ups. Similarly Deakins, O'Neill and Mileham (2000) suggest that the board's roles in small start-ups is not just limited to the oversight tasks.

To sum up, it is suggested there are rationales behind the apparent anomaly observed in the governance structure of PCROs. The governance structure of PCROs is plausibly explained by the presence of an agency problem. In a comprehensive study of U.S. public agricultural research investments, Alston et al. (2011) show public agricultural research has measurable impacts 40 years after the investment is made, and the peak impact occurs 25 years after the investment was made. Similarly, in the case of the PCROs, investment outcomes are realized several years after the investments are made. Therefore, assigning the whole decision-making task to the manager is a possible source of an agency problem.

If the manager's performance is measured with a great deal of delay and uncertainty, the manager may not provide an optimal effort, as he is not incentivized properly. In addition, the PCROs may not be able to hire the managers with high quality decision-making skills. Moreover, the manager is likely to direct resources towards the projects whose returns are realized in the short-run. Thus, the PCROs will have an unbalanced investment portfolio and fail to fulfill their missions.

Therefore, because the PCROs are complex organizations (Fama & Jensen, 1983) and as their directors have high opportunity costs to allocate most of their time in the PCROs, these entities have to hire managers with high quality decision-making skills. However, the nature of investments in PCROs and long horizon investments in them are the important sources of agency problem. Thus, the directors as the patrons have to be involved in the management decisions to provide proper incentives for the management team and direct investments to the areas benefiting other patrons.

2.7. Concluding Remarks

Using a series of interviews with the managers or directors of fourteen organizations involved in agricultural R&D, this chapter reviewed and compared the governance structure and the decision-making processes of PCROs. In the context of case-study methodology, this chapter highlights some of the main features of the PCROs governance structures and decision-making process. It also provides a background for the PCROs in the context of literature and indicates that the cases studied could be used to generate theories around the governance of PCROs.

Based on property rights structure and the characteristics of the directors of PCROs, these organizations should be defined as NP organizations. Following Hansmann (1980), this chapter also classified the PCROs. In the sample, with the exception of a single organization (GRDC), the rest are considered as donative-mutual NP organizations because farmers fund and govern these organizations. There are also several PCROs in the sample that commercialize the results of their investments and therefore they can be classified as commercial-mutual NP organizations.

In most of PCROs, farmers directly elect the directors of these NP organizations. However, in four PCROs government officials, following the nomination by regional agricultural sector organizations, appoint the directors. In most of the organizations, the directors are elected or

appointed based on their local attachment or crop districts. In the case of Saskatchewan, the regional attachment does not play any role in the determination of board members directly.

The chapter also distinguished between five stages of decision-making in the sample PCROs: determination of priorities, request for proposals (RFP), review and ranking of proposals, measuring performance and finally collecting information about grower feedback and their research interests.

Interestingly, in contrast to the theories and several empirical studies, the directors in 13 out of 14 PCROs in the sample play crucial roles in making managerial decisions. It is posited that the governance structure of PCROs stems from an agency problem.

Based on the interview responses it appears the PCROs use different methods to rank projects. To varying degrees GRDC, USB, WGRF, ISCP, ICPB and KWC make their decisions through explicit ranking mechanisms. The exception is ICPB, which for the most part, uses an economic-based ranking method. When using explicit ranking methods, projects are usually reviewed and ranked based on additive ranking or scoring methods. Also, the rest of the organizations usually rely on a research committee, external advisors or board of directors to choose amongst the projects where the share of each factor is not explicitly defined.

Chapter 3: Who Governs Producer Controlled Research Organizations in the Agricultural sector, and Why?

3.1. Introduction

Producer controlled research organizations (PCROs)⁴ in the agricultural sector are charged with the task of investing millions of dollars of checkoff revenues in R&D and promotion projects. These organizations came into existence because both the public and private sectors failed to invest in agricultural R&D sufficiently and efficiently (Alston et al., 2012). Previous studies show that PCROs' investments usually yield substantial rates of return, often over very long time horizons (Alston, Chan-Kang, Marra, Pardey, & Wyatt, 2000; Gray & Scott, 2003) suggesting PCROs could notably improve the welfare of farmers and consumers. Regarding the significance of PCROs in the improvement of producers and consumers' well-being, it is important to know how the decisions are made in these organizations and by whom.

To the best of my knowledge, the governance structure and decision-making process of these organizations have not been studied systematically. To begin to fill this gap, a series of interviews was conducted with the managers and directors of fourteen PCROs across Australia, the United States and Canada to evaluate the governance structure and decision-making process of these organizations.⁵ During these interviews, it became clear that the boards of directors play important roles in the governance of PCROs and are both involved in the management and oversight decisions. This observation is in contrast with most of the theories and empirical studies focusing on the governance structure of NP and FP organizations (Brown & Guo, 2010; Fama & Jensen, 1983; Miller-Millesen, 2003).

Given this apparent anomaly, this chapter poses and attempts to answer to the following question: Why do PCROs tend to assign a substantial portion of managerial decisions to their

⁴ Throughout the dissertation I use PCROs to refer to producer controlled research organization whose main roles are to develop and promote agriculture commodities using levies paid by farmers.

⁵ The results of these interviews are presented in the previous chapter.

boards of directors instead of managers? To answer this question, a theoretical model is developed that is based on agency theory with focus on task(s) delegation literature (Bester & Kräbmer, 2008; Holmstrom & Milgrom, 1991; Itoh, 1994; Riordan & Sappington, 1987). The model considers a PCRO whose primary job is to maximize the return on agricultural producers' levies by investing them into R&D and market promotion projects. Based on this objective function, the PCRO decides to assign the decision-making task to the manager or the board of directors.

In the model, the manager and the board of director are considered as the agents of the PCRO that have different motivations for exerting efforts. The directors of the PCROs as farmers or agricultural sector beneficiaries receive monetary benefits from the PCRO's investments proportional to their share of the industry. In addition, it is assumed that a director's utility can be positively affected through altruism and learning in the process of decision-making⁶.

In contrast to the board of directors, the manager exerts effort in return for financial compensation. The compensation package of the manager in this model includes a base salary and a bonus. The bonus paid using some performance measure of output or expertise and effort of the manager. Arguably the very long research lags and the lack of a market valuation of the non-profit research portfolio could preclude any timely measurement of output for the PCRO. Therefore, manager's compensation based on a measure of PCRO's outcome(s) may not be a proper tool to incentivize the manager (Sappington, 1991). For organizations willing to measure the input of managers and reward them accordingly, the presence of a third party (e.g. the board of directors) could potentially improve the accuracy of such a measure by reducing the variance of the performance measure.

Given the PCRO's objective and the characteristics of the agents, the organization decides whether to assign the task of decision-making to directors or the manager. This choice is determined by several factors, including the characteristics of the directors, the knowledge levels of the manager and board members, and the ability to incentivize the effort of the manager based on the imperfectly measured output or decision-making input.

⁶ Some PCRO's pay their directors a nominal per diem that is assumed to be trivial.

In the case of an output-based bonus, the results of the model suggest the PCRO decides to assign the task to either the almost perfectly incentivized manager or directors, depending on their relative effectiveness. A separation of decision-making and oversight would exist in this case, over a range of plausible parameter values. However, when the manager's reward is based on his input, given similar characteristics of the directors and the manager, the shared decision is more likely to be the norm if the directors are not significantly altruistic. However, if the board members are highly altruistic, the PCRO decides to share the decision-making contingent upon the superiority of manager's input quality, including knowledge level or cost of exerting efforts. In these situations, the directors will generally also participate in management in order to both incentivize managerial effort and help the PCRO to reach its objectives. These results, which will be derived in the remainder of this chapter, provide a useful theoretical framework to model PCROs decision-making.

The remainder of this chapter is organized as follows: in Section 2, there is a brief review some of the previous studies, Section 3 presents some features of PCROs governance structures, based on interviews. Section 4 discusses the manager's compensation package and output observability in PCROs. The theoretical model is presented in Section 5 and the chapter conclusion is in Section 6.

3.2. Review of Previous Studies:

There are three theories used in explaining the roles of the board of directors in NP organizations; these theories are institutional theory, resource dependency theory and agency theory (Miller-Millesen, 2003; Brown, 2005). Although one could use the institutional theory and resource dependency theory to explain the assignment of management decisions to the board of directors by PCROs, in this paper I focus on the agency theory to account for this observation. This is because agency theory implies the separation of management and oversight, however this observation is in contrast with such implications. Therefore, given the characteristics of the PCROs presented in the previous chapter, I examine whether the agency theory can explain the lack of oversight and management tasks' separation or not.

Agency theory implies that the roles of the board of directors in NP organization are primarily limited to monitoring of managers and aligning organizational activities toward its objectives (Fama & Jensen, 1983; Miller-Millesen, 2003). However, the broader principal-agent

literature suggests the delegation of tasks can be influenced by information asymmetries. The literature suggests the principal would delegate a job to one agent if it was hard to measure the performance of each agent separately (Holmstrom & Milgrom, 1991). The reason behind this choice is that agents are not motivated to exert optimal efforts if they cannot be incentivized based on their individual performances. On the other hand, if the principal can observe the inputs of each party in the team's production, she hires more than one agent to perform the tasks (Itoh, 1994). Moreover, the delegation of authority to an agent over choosing a project may not be an optimal choice, especially if the agent is secured against his action by limited liability constraint (Bester & Krämer, 2008). Furthermore, if there is information asymmetry, the choice of the delegation of tasks to agents, is the function of the correlation between the costs of performing the tasks (Riordan & Sappington, 1987).

3.3. Decision-Making Process and Governance Structure of PCROs: mutual or entrepreneurial

Hansmann (1980) discusses that the patrons of NP organizations have tendency to exercise some degrees of control over the NP organizations because they can trace their contributions in these entities. This is specially the case where patrons consume the products of NP organizations on a regular basis. Hansmann (1980) differentiates between four types of NP organizations based on funding sources and the agent(s) who control(s) these entities. The parties that fund the NP organizations by their donations are called “patrons”. According to Hansmann (1980) NP organizations can be controlled by their patrons or they can hire others to run the NP enterprises. The former, controlled by patrons, are classified as “mutual” and the latter as “entrepreneurial” NP organizations.

However, the patrons will not have the tendency to participate in NP organizations' control (i.e. the organization shifts from mutual to entrepreneurial governance structure) if the marginal benefit of the participation in governance of NP organizations is smaller than the marginal cost of allocating time and resources (Ben-Ner, 1994; Ben-Ner & Van Hoomissen, 1991; Hansmann, 1980).

Given Hansmann's classification of NP organizations, one purpose of this chapter is to provide a theoretical explanation behind the choice of mutual or entrepreneurial governance structure. Hence, in this section the governance structure of PCROs in the sample are shortly

reviewed. The information provided below will be used later in this chapter to develop the analytical model providing a possible explanation of why PCROs choose to be a mix of mutual and entrepreneurial types of NP organizations.

The primary purpose of the PCROs is to invest collected levies into R&D and market promotion projects to benefit the producers. Managers or elected/appointed directors run the PCROs. In other words, the PCROs are a combination of mutual and entrepreneurial NP organizations. These organizations rarely own any agricultural research facilities and primarily rely on research entities such as universities or private companies involved in the agricultural research. Therefore, the PCROs could be considered as funding bodies allocating their resources to proposed research. In other words, the PCROs do not have to incur substantial fixed costs for their investment decisions and their main cost component is the variable costs of their agents' compensations.

Although there might be some differences in the process of decision-making of PCROs interviewed, the investment decisions are usually made according to a similar process in these organizations. In most of the cases, the PCROs first determine their research priorities and then the researchers from universities or private research entities are invited to propose research projects. The proposals are evaluated by the research committees, encompassing directors (i.e. patrons) and research managers. The research committees use member expertise or external reviewers' reports to provide a recommendation for the board about each proposal.

Research committee recommendations are usually based on the PCRO's research priorities, the value of the projects in terms of the potential benefit to farmers, scientific feasibility and other criteria. By use of these guidelines, the board that only includes the elected or appointed patrons decides whether to fund a proposal or not.

Although the process of decision-making explained above might be similar to other organizations in terms of the stages of the decision-making, the outcomes of the interviews and comparison with other studies (Brown & Guo, 2010; Fama & Jensen, 1983; Miller-Millesen, 2003) indicate that there is a significant difference between PCROs and other NP and for-profit entities. In fact, in all of the PCROs (except GRDC), the directors are assigned significant responsibilities in more-or-less every stage of decision-making. In other words, the directors are not just in charge of oversight, they are also involved in management decisions, this includes determining the priorities, reviewing and ranking the proposals, making investment decisions

and reflecting farmer feedback and research interests. This structure of control suggests that the PCROs primarily are classified as mutual and entrepreneurial and they are mostly located near the mutual end of the spectrum.

In return for the directors' efforts, they either receive nominal per diem payments, or they are not compensated at all. However, a director could receive three types of compensations by both being a farmer and exerting efforts in the PCROs: 1) The directors are agricultural sector beneficiaries and they gain from PCROs investments proportional to the size of their own business. 2) The interviewees expressed several times during the interviews that directors care about other farmers. In other words, it seems that altruism plays a key role in incentivizing directors to spend effort in PCROs. Given this observation and by following Besley and Ghatak (2005) one could assume directors could be mission-oriented agents, motivated to exert efforts in the PCROs because they care about a PCRO and its beneficiaries. 3) The interviews also support considering a director might benefit as a results of his/her involvement in the decision-making process of a PCRO by learning about new technologies and business opportunities. This knowledge is achieved in the course of making investment decisions implying that the board members gain additional utility by exerting extra efforts. In other words, the considerable involvement of the directors in PCROs suggests that they gain a marginal benefit by extra efforts that they exert in the PCROs. This extra benefit is expected to be greater than the marginal costs of their involvement.

In sum it was observed that the PCROs are a mix of mutual and entrepreneurial NP organizations while the weight of patrons in controlling these enterprises are notably higher than the managers. In addition, since the directors are the beneficiaries of PCROs, they use the products of these organizations on a regular bases and the net benefit of their involvement is greater than zero. However, it should be noted that the positive gain for the directors is not necessarily monetary as they might be motivated by other factors such as altruism.

3.4. Manager's Compensation Packages and Output Observability in PCROs

In comparison with the directors, the managers of PCROs sampled did not have any farming activities. Therefore, it is safe to assume that the managers exert efforts primarily for financial incentives. However agricultural research typically has a very long gestation lag (Alston et al., 2011). A comprehensive study of U.S. public agricultural research investments

showed public agricultural research has measurable impacts 40 year after the investment was made, and the peak impact occurs 25 years after the investment is made (Alston et al., 2011). With these long timelines, rewarding manager performance based on research outcomes might not be practical. Therefore a contract incentivizing a manager where the observation of output is considerably noisy (which is the case in PCROs) could differ from what the private sector offers to executives (Fulton & Pohler, 2015; Glaeser & Shleifer, 2001; Roomkin & Weisbrod 1999).

In NP organizations, the compensation packages provided to the managers often include both base salary and bonus payments (Hallock, 2002). However, the managers of NP organizations receive considerably less total compensation in comparison with for-profit organizations (Hallock, 2002; Handy & Katz, 1998; Roomkin & Weisbrod, 1999). The lower levels of payments to the managers of the NP organizations in comparison with FP enterprises is related to lack of non-distribution constraints and difficulties in measuring the performance of the management team (Preyra & Pink, 2001)

In the private sector there are different types of incentives offered to a manager, including base salary, bonus payment, stock options and long-run performance incentives. In the case of bonuses, the companies in the private sector use one or more than one performance measures to reward their managers (Murphy, 1999). The performance evaluation methods used in private enterprises include accounting performance measures (i.e. some measures of profit or income) and “non-financial” performance measures. The most frequently used non-financial performance measure is “individual performance,” measured according to pre-determined objectives and subjective evaluations of the manager’s individual performance (Murphy, 1999).

Using a series of interviews with managers of fifteen cooperatives, Hueth and Marcoul (2009) show co-ops use different payment schemes for rewarding managers through the use of bonuses. The authors suggest the use of implicit contracts is common in co-ops. Also the authors hypothesize, as the directors in co-ops have a better understanding of the managers’ real efforts, they could at least partially reward the managers based on the direct observation of efforts. However, their interviews imply that this hypothesis can be rejected, as they observed the directors are not actively involved in the management decisions.

3.5. Theoretical Model

The model presented in this section is based on the following scenario: the objective function of the PCRO is to maximize the present expected value of the research investments, y , minus investment costs, minus operating costs, which are invariant to the decision-making process and include fixed wage and bonus payments to the manager.

The model assumes the value of output from the decision-making function is as follows: the quality of the research decision, measured in terms of y , made by an agent i (M and B) is product of his knowledge level, k_i and effort, e_i . The quality of the research decision of the PCRO is an average of the quality of the research decision making of directors, $e_B k_B$, and the quality of the decisions making of the manager $e_M k_M$ weighted by the δ and $1 - \delta$ where $\delta \in [0,1]$.

$$y = \delta e_B k_B + (1 - \delta) e_M k_M \dots \dots \dots (3.1)$$

These choices of the PCRO are taken into account in two different scenarios. In the first scenario, I assume the PCRO's output is measureable and in the second scenario I assume because of the friction in measuring the PCRO's outcomes, the organization rewards the manager based on a measure of his input.

The PCRO makes the choices in a three-stages game. In the first stage, the PCRO chooses the weight of each agent, the board of directors and the manager, in the decision-making process. In the second stage, the PCRO decides about the components of the payment scheme. In the third stage, the manager and directors both as risk neutral agents, choose the amounts of effort that they are going to expend in the course of decision-making.

3.5.1. Rewarding the manager based on a measure of output.

The manager's reward, in terms of the bonus, could be based on the output of the organization (e.g. profit or in the case of PCROs additional yield for farmers or return on investments). Therefore, the stages of the game are as follows:

Stage 3:

In the third stage of the game, the manager and directors decide about the levels of efforts they are going to exert in the PCRO. As previously mentioned the PCRO's output is $y = \delta e_B k_B + (1 - \delta) e_M k_M$. However, following Alston et al. (2011) it is assumed that the outcome

is not observable in the short-run. Therefore, the PCRO has to use a performance measure to evaluate the value generated by investments. This value is assessed by the performance measure of α_y . In this case, the setup presented in Baker, Gibbons, and Murphy (1994) is used to specify the implication of performance measure on the choice of agents' weights in the decision-making process. It is assumed that α_y on average yields an unbiased measure of outcome ($E[\alpha_y] = 1$). However, there are some years in which α_y renders a higher (lower) measure of the output, implying that the payment to the manager is proportionally higher (lower) than the manager's contribution. In other words, measure of the performance has some variance indicated by σ_y^2 ($Var[\alpha_y] = \sigma_y^2$).

Therefore, in each year, the PCRO observes $\hat{y} = \alpha_y \cdot y$ and it pays the bonus of b per unit of \hat{y} . The manager also receives the fixed salary of F . Following Baker et al., (1994) it is assumed that the manager only knows there is a performance measure in the PCRO, however he can only realize the mechanism of α_y when he starts to work in the organization and not before accepting the contract. In this setting, although the manager is risk neutral he will have to be compensated for the uncertainty of the performance measure in terms of the fixed payment because of the incomplete information about the performance measure's mechanism.

The manager receives $F + b \hat{y}$ and incurs the cost of $1/2 c_M e_M^2$. Thus, the net utility of the manager because of exerting efforts in the PCRO is indicated in equation (3.2):

$$U_M = F + b \hat{y} - \left(\frac{1}{2} c_M e_M^2\right) \dots\dots\dots (3.2)$$

The manager maximizes (3.2) with respect to e_M that is: $\max_{e_M} U_M = F + b \hat{y} - \left(\frac{1}{2} c_M e_M^2\right)$

Consequently, the efforts exerted by the manager is shown in equation (3.3):

$$e_M^* = \frac{k_M}{c_M} [b \alpha_y (1 - \delta)] \dots\dots\dots (3.3)$$

Equation (3.3) denotes optimal effort of the manager is a positive function of his knowledge (k_M), bonus of b and weights of manager in the process of decision-making that is $(1 - \delta)$. It is also assumed that the manager's reservation wage is equal to \bar{w} , therefore, the

lowest amount of expected F satisfying manager's participation's constraint is shown in equation (3.4) and this is the optimal base salary that PCRO pays to the manager.

$$E[F] = E \left[\bar{w} - b \hat{y} + \left(\frac{1}{2} c_M e_M^2 \right) \right] \dots \dots \dots (3.4)$$

Taking the expected value from both side one can write equation (3.4) as follows $E[F] = \bar{w} - by + (k_M^2/2 c_M)b^2(1 - \delta)^2 E[\alpha_y]^2$. Considering the assumptions that $E[\alpha_y] = 1$ and $\text{Var}[\alpha_y] = \sigma_y^2$ gives $E[\alpha_y^2] = 1 + \sigma_y^2$ resulting in: $E[F] = \bar{w} - by + (k_M^2/(2 c_M))b^2(1 - \delta)^2(1 + \sigma_y^2)$. Therefore, although the manager is assumed to be risk-neutral, since he has quadratic cost function, as the friction of the organization's performance measure increases, the PCRO should offer the manager higher fixed payment to satisfy his participation constraint. Based on the PCRO's payment to the manager, the organization's expected profit is shown in equation (3.5):

$$E[\pi] = \delta e_B k_B + (1 - \delta) e_M k_M - \bar{w} - \left(\frac{1}{2} c_M E[e_M^2] \right) \dots \dots \dots (3.5)$$

The board members are the beneficiaries of the industry research and market development. Therefore, their utility is positively associated with the returns on the PCRO's investments. The interviews also support the supposition the board members' altruism and learning capacity positively affect their incentives.

$$U_B = (\rho + \theta (1 - \rho))\pi + g \cdot \rho \cdot \delta e_B k_B - \frac{1}{2} c_B e_B^2 \dots \dots \dots (3.6)$$

In equation (3.6) $\rho \in [0,1]$ is the share of the board member from the industry. So if a director is a farmer, ρ could be considered as the relative size of his/her farm to the industry. Following Besley and Ghatak (2005) it is assumed that directors could be mission-oriented agents and they are motivated to exert efforts in the PCROs by both pecuniary (ρ and $g \geq 0$) and non-pecuniary (θ) factors. Hence, a board member could also consider the factor of $\theta \in [0,1]$ as the degree by which he/she values the success of the rest of the industry members. It implies the higher values of θ correspond with higher efforts exerted by the directors. For

instance, if $\theta = 1$ a director exerts efforts in the PCRO as if he or she owns the whole industry while if $\theta = 0$, the effort of the director will be only proportional to ρ .

Directors also gain from involvement in the PCROs' activities in the form of learning about new technologies, networking opportunities and so on. This gain is indicated by parameter $g \geq 0$ that is proportional to the directors' input and weight attached to it in the decision-making process and their share of industry (i.e. $g \cdot \rho \cdot \delta e_B k_B$). Finally, $1/2 c_B e_B^2$ is the cost of exerting efforts incurred by board of directors. The directors maximize (3.7) with respect to e_B that is:

$$\max_{e_B} U_B = (\rho + \theta (1 - \rho))\pi + g \cdot \rho \cdot \delta \cdot e_B k_B - \frac{1}{2} c_B e_B^2$$

$$e_B^* = \frac{\delta k_B (g\rho + \rho + \theta(1-\rho))}{c_B} \dots\dots\dots (3.7)$$

A board member's optimal effort illustrated in equation (3.7) is an increasing function of $\delta, g, \rho, \theta, k_B$ and decreasing function of his/her marginal cost of exerting efforts.

Stage 2:

In this stage of the game, PCROs determine the optimal bonus of b and F by maximizing its expected return:

$$\max_b E[\pi] = E \left[\delta e_B k_B + (1 - \delta) e_M k_M - \bar{w} - \left(\frac{1}{2} c_M e_M^2 \right) \right] \dots\dots\dots (3.8)$$

Substituting equations (3.3) and (3.7) into (3.8) we have:

$$\max_b E[\pi] = E \left[b \alpha_y \frac{k_M^2}{c_M} (1 - \delta)^2 + \frac{\delta^2 k_B^2 (g\rho + \rho + \theta(1-\rho))}{c_B} - \bar{w} - \frac{1}{2} \left(b^2 \alpha_y^2 \frac{k_M^2}{c_M} (1 - \delta)^2 \right) \right] .$$

that based on the expected values is:

$$\max_b E[\pi] = b \frac{k_M^2}{c_M} (1 - \delta)^2 + \frac{\delta^2 k_B^2 (g\rho + \rho + \theta(1-\rho))}{c_B} - \bar{w} - \frac{1}{2} \left(b^2 (1 + \sigma_y^2) \frac{k_M^2}{c_M} (1 - \delta)^2 \right)$$

The first order condition of the PCRO's problem in the second stage of the game is:

$$\frac{\partial E[\pi]}{\partial b} = \frac{k_M^2}{c_M} (1 - \delta)^2 - b \left((1 + \sigma_y^2) \frac{k_M^2}{c_M} (1 - \delta)^2 \right) = 0$$

Solving for b , we get to the optimal outcome-based bonus paid to the manager shown in equation (3.9):

$$b^* = \frac{1}{1 + \sigma_y^2} \dots \dots \dots (3.9)$$

Equation (3.9) implies that, as the variance of the performance measure increases, the manager's payment decreases, weakening incentives for exerting efforts in the PCRO.

Taking into account the nature of investments' return in agriculture R&D it is known that the outcomes of these types of investments are usually realized several years after the investments are made, suggesting that the use of any ex-ante performance measure could be accompanied with considerable variance. Therefore, one may discuss that the managers of PCROs will be less incentivized, when compared to other types of organizations, if they are rewarded based on the outcome of investments.

Also, the first-best effort level of the manager is $e_M^{**} = (1 - \delta)k_M/c_M$ where in presence of the noise in evaluation of the outcome (i.e. σ_y^2) the effort of the manager is $e_M^* = (1 - \delta)k_M/[c_M \cdot (1 + \sigma_y^2)]$. Therefore, the higher variance of output performance measures distracts the manager from expending e_M^{**} .

In addition, the performance measure of α_y does not measure the contribution of each agent in the investment decision made. Therefore, if the decisions are made by both the manager and the board of directors (i.e. $\delta \in (0,1)$). The manager could act as a free rider or lose his incentives if his contribution is not realized separately.

Stage 1:

In this stage, the PCRO determines the weight of each agent's input into the decision-making process. By substituting (3.9) into (3.8) we have:

$$\pi^*(\delta, \dots) = \frac{1}{2} \left(\frac{1}{1 + \sigma^2} \right) \left(\frac{(1 - \delta)^2 k_M^2}{c_M} \right) + \frac{\delta^2 k_B^2 (g\rho + \rho + \theta (1 - \rho))}{c_B} - \bar{w} \dots \dots \dots (3.10)$$

Equation (3.10) implies that the return function of the PCRO is convex in δ . In other words, because the efforts of the agents are directly associated with their input weights (i.e. δ and $1 - \delta$), therefore, each agent is willing to have higher weight in the process and the PCROs' has to employ only one of the agents for making the investment decisions. Therefore, the ideal

value of δ in this case is either equal to zero or one. In other words, the PCRO has to assign the decision-making authority only to one of the agents.

For instance, if $\delta^* = 1$, therefore the board will be in charge and $\pi^*(\delta = 1, \dots) = k_B^2(g\rho + \rho + \theta(1 - \rho))/c_B - \bar{w}$ which in terms of the board's optimal input is equal to $e_B^*k_B - \bar{w}$. Similarly, if $\delta^* = 0$, the manager becomes the decision-making agent and $\pi^*(\delta = 0, \dots) = (1/(1 + \sigma^2))(k_M^2/2 c_M) - \bar{w}$ which is equal to $1/2 e_M^*k_M - \bar{w}$. Therefore, if $1/2 e_M^*k_M > e_B^*k_B$, the manager becomes in charge of the decision making, otherwise the PCRO assigns the job to the board of directors. In other words, if the relative quality of the research decision-making of the manager is defined as $e_M^*k_M/e_B^*k_B$, the board of directors will become the decision-making agent if its decision-making quality is two times more than that of the manager, otherwise the PCRO will delegate the decision-making to the manager and $\delta^* = 0$. One can also rewrite equation (3.10) as follows:

$$\pi = \frac{\left(\frac{1}{2}\right)(1-\delta)^2 M}{1+\sigma_y^2} + X \cdot B \cdot \delta^2 - \bar{w}$$

where $M = \frac{k_M^2}{c_M}$, $B = \frac{k_B^2}{c_B}$, $X = g\rho + \rho + \theta(1 - \rho)$. Based on this new format, Figures 3.1 and 3.2 plot the expected return of the PCRO against the weight of the board in the decision-making process where in the first figure the $X = 1$ and in the second figure $X = 1/100$. In other words, in Figure 3.1 the directors are assumed to be highly altruistic while in the Figure 3.2 they only care about themselves.

As it is indicated in Figure 3.1, where the board is notably altruistic, the PCRO prefers to assign the decision-making task to the manager if his knowledge level is higher than that of the board or if it is less costly for him to exert effort (i.e. $M = 3$). In other words, for lower values of M the PCRO's choice of δ is equal to one.

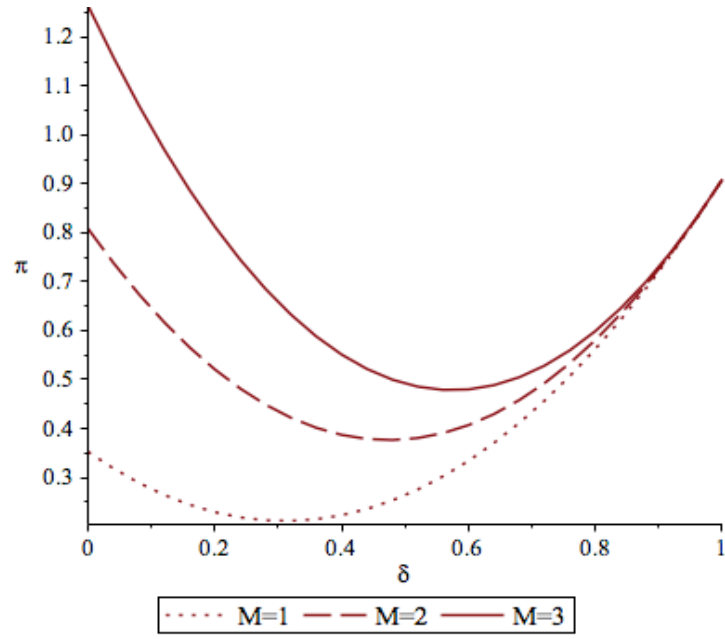


Figure 3.1. The choice of δ where $\bar{w} = 1/10, \sigma_y^2 = 1/10, X = 1, B = 1$

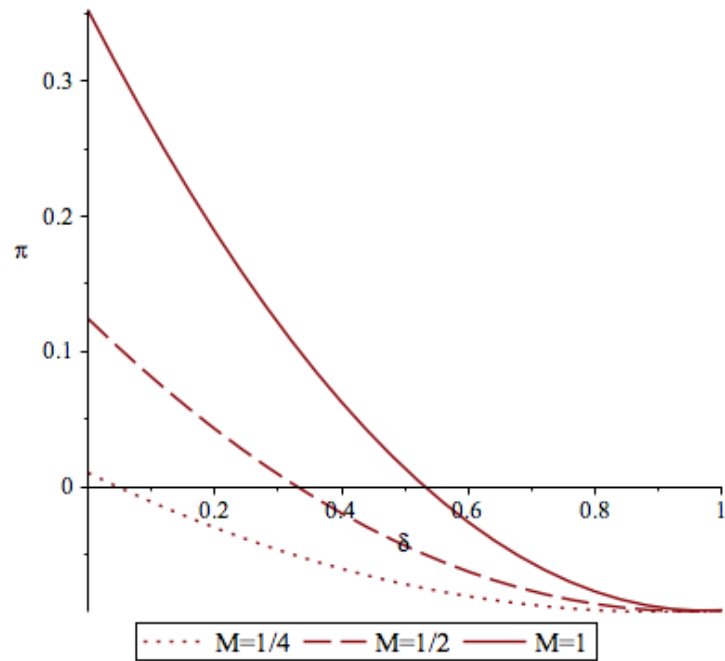


Figure 3.2. The choice of δ where $\bar{w} = 1/10, \sigma_y^2 = 1/10, X = 1/100, B = 1$

However, in Figure 3.2 we have $X = 1/100$ that is the board members primarily care about their share of industry. As it is shown in Figure 3.2, in the presence of self-interested board, even if the manager's input characteristics including knowledge or marginal costs are much lower than the that of the board (i.e. $M = 1/4$) the PCRO still prefers the manager over the board. In other words, altruism is the primary feature of the board that could stimulate the organization to use the board instead of the manager.

Given Haussmann's categorization of NP organizations one could discuss that if the manager rewards are based on the outcome of PCROs' investments, the PCROs' control status will be either mutual or entrepreneurial.

3.5.2. Rewarding the manager based on a measure of input.

A compensation plan encompassing reward based on a measure of input could be a more operative tool to incentivize the manager where there are noteworthy frictions in measuring the output (Sappington, 1991). However, measuring the manager's contribution is contingent upon the presence of a third party evaluating his input. In the model this third party is the board of directors. In this setting, the board of directors is involved in the decision-making along with the manager and it also assesses the quality of decision-making of the manager, and the PCRO rewards him accordingly. In this scenario it is assumed the involvement of the board of directors in the decision-making process affects the performance measure of the manager's input through lessening the discrepancy of the performance measure.

Stage 3:

In this stage of the game the manager and the board adopt the levels of efforts they are going to exert in the PCRO. The PCRO's output (i.e. $y = \delta e_B k_B + (1 - \delta) e_M k_M$) is realized through the combination of the board and manager efforts, enhanced by their knowledge levels. The payment of the premium to the manager is conditional upon the measurement of the quality of his input into the decision-making (i.e. $e_M k_M$). Therefore, the presence of the board of directors in the process of decision-making improves the quality of the performance measure (i.e. it reduces the variance of the performance measure). Equation (3.11) denotes the net utility of the manager where he is rewarded based on the quality of his input.

$$U_M = F + \beta \alpha_e e_M k_M - \left(\frac{1}{2} c_M e_M^2 \right) \dots \dots \dots (3.11)$$

In equation (3.11), F is the base salary paid to the manager. In addition, the manager receives β per unit of input exerted. However, $e_M k_M$ is assessed by a performance measure (i.e. α_e) that on average yields an unbiased measure of $e_M k_M$. This performance measure encompasses some noises. However, the size of the variance is reduced by the presence of the board of directors in the course of the decision-making. In other words, $\alpha_e \sim (1, \sigma_e^2/\delta)$ implying that as the weight of the board of directors in the process of decision-making rises, α_e measures the $e_M k_M$ with more precision. However, if δ approaches zero, the use of this evaluation method will not be plausible.

Following Baker et al., (1994) I suppose the manager only knows there is a performance measure in the PCRO, however he does not know how α_e works before accepting the offer. The manager maximizes (3.11) with respect to e_M and consequently the effort that he is going to exert is shown in equation (3.12)

$$e_M^* = \beta \alpha_e \frac{k_M}{c_M} \dots \dots \dots (3.12)$$

Equation (3.12) denotes that optimal effort of the manager is a positive function of his knowledge (k_M), bonus of β , and the weight of the board in the decision made. Comparable to the previous case, the board of directors' optimal effort is:

$$e_B^* = \frac{\delta k_B (g\rho + \rho + \theta(1 - \rho))}{c_B} \dots \dots \dots (3.13)$$

Stage 2:

In this stage of the game, the PCRO determines the optimal bonus β and the base salary of F by maximizing its expected yield:

$$\max_{\beta} E[\pi] = E \left[\delta e_B k_B + (1 - \delta) e_M k_M - \bar{w} - \left(\frac{1}{2} c_M e_M^2 \right) \right] \dots \dots \dots (3.14)$$

Substituting equations (3.12) and (3.13) into (3.14) the PCRO maximizes (3.15) with respect to β :

$$\max_{\beta} E[\pi] = \frac{(1-\delta) \beta \delta k_M^2}{c_M} + \frac{\delta^2 k_B^2 (g+\rho+\theta(1-\rho))}{c_B} - \frac{1}{2} \frac{\beta^2 \left(1 + \frac{\sigma_e^2}{\delta}\right) \delta^2 k_M^2}{c_M} - \bar{w} \dots \dots \dots (3.15)$$

The first order condition of PCRO's maximization problem in determination of β is:

$$\frac{\partial E[\pi]}{\partial \beta} = \frac{(1-\delta) \delta k_M^2}{c_M} - \frac{\beta \left(1 + \frac{\sigma_e^2}{\delta}\right) \delta^2 k_M^2}{c_M} = 0. \text{ Therefore, the optimal input-based bonus paid to the}$$

manager is:

$$\beta^* = \frac{(1-\delta)\delta}{\delta + \sigma_e^2} \dots \dots \dots (3.16)$$

In this situation, the expected optimal effort of the manager is $E[e_M^*] = (1-\delta)\delta k_M / ((\sigma_e^2 + \delta)c_M)$. Comparing this level of effort with the first-best effort level that is $e_M^{**} = (1-\delta)k_M/c_M$ one can see that as σ_e^2 increases, the manager's effort diverts from first-best effort level.

Figure 3.3 plots the optimal bonus paid to the manager against the weight given to the board, in the process of decision-making. The optimal input-based bonus paid to the manager is the increasing function of the manager's weight in the process and decreasing function of σ_e^2 , however as the weight of the board of directors increases the negative impact of σ_e^2 on the size of the bonus will decline.

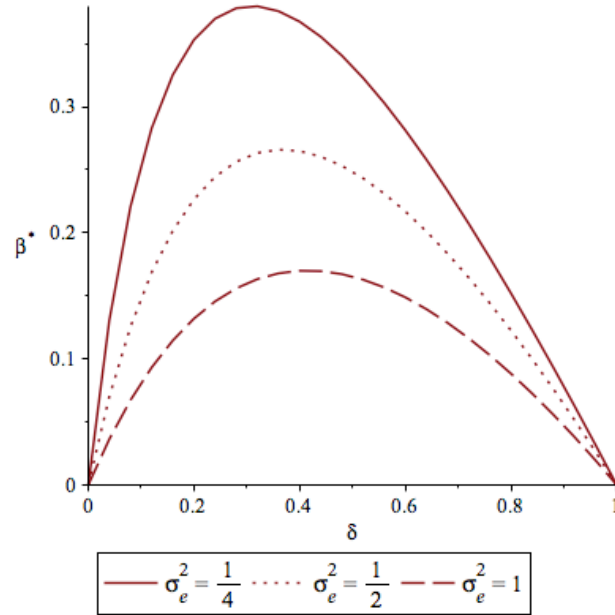


Figure 3.3. Optimal bonus paid to the manager based on the variance of input performance measure.

Stage 1:

In this stage, the PCRO determines the weight of each agent's input into the decision-making process. By substituting (3.16) into (3.15) we have:

$$\pi^*(.) = \left(\frac{(1-\delta)^2 \delta k_M^2}{c_M(\delta + \sigma_e^2)} \right) + \frac{\delta^2 k_B^2 (g\rho + \rho + \theta(1-\rho))}{c_B} - \bar{w} - \frac{1}{2} \left(\frac{(1-\delta)^2 \delta^2 \left(1 + \frac{\sigma_e^2}{\delta}\right) k_M^2}{c_M(\delta + \sigma_e^2)} \right) \dots (3.17)$$

This equation can be written in the form of equation (3.18)

$$\pi^*(.) = \frac{M}{2} \left(\frac{(1-\delta)^2 \delta}{(\delta + \sigma_e^2)} \right) + XB\delta^2 - \bar{w} \dots (3.18)$$

where in equation (3.18) $M = k_M^2/c_M$, $B = k_B^2/c_B$ and $X = g\rho + \rho + \theta(1-\rho)$. To illustrate the choice of PCRO's optimal solution of δ (weight of the board of directors in the decision-making process) we use the of plot $\pi^*(.)$ against δ .

The choice of δ in the presence of highly altruistic board

Let's assume that the board of directors is highly altruistic or $\theta = 1$ so if the board does not learn anything in the process of decision-making, X will be equal to one. Figure 3.4 and 3.5 plot the expected return of the PCRO against the board's weight in the process of decision-making where $\bar{w} = 1/10$, $X = 1$ and $B = 1$. The only difference between these two figures is the value of σ_e^2 , where in Figure 3.4 it is equal to $1/10$ and in Figure 3.5 it is equal to $1/5$. In this figure I am looking for the choice of δ where manager's characteristics of input ($M = k_M^2/c_M$) varies.

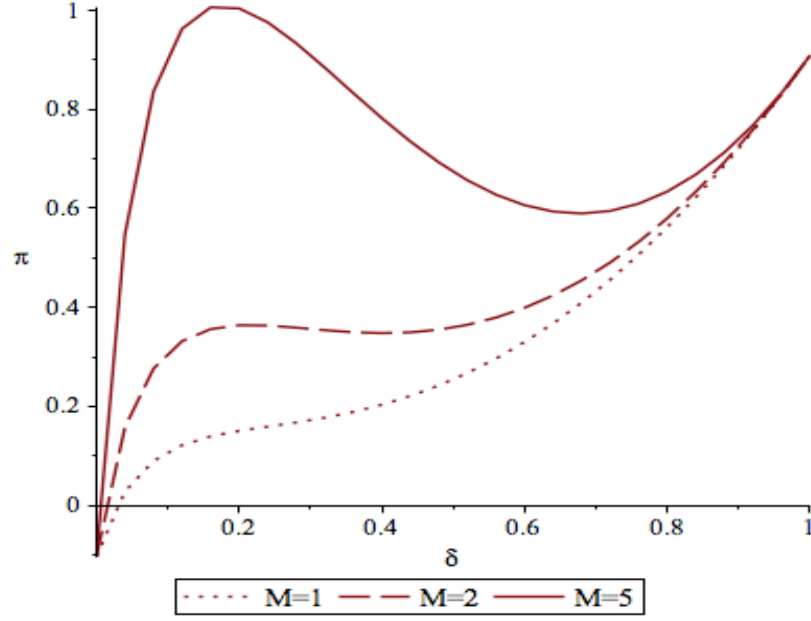


Figure 3.4. The choice of δ where $\bar{w} = 1/10$, $\sigma_y^2 = 1/10$, $X = 1$, $B = 1$

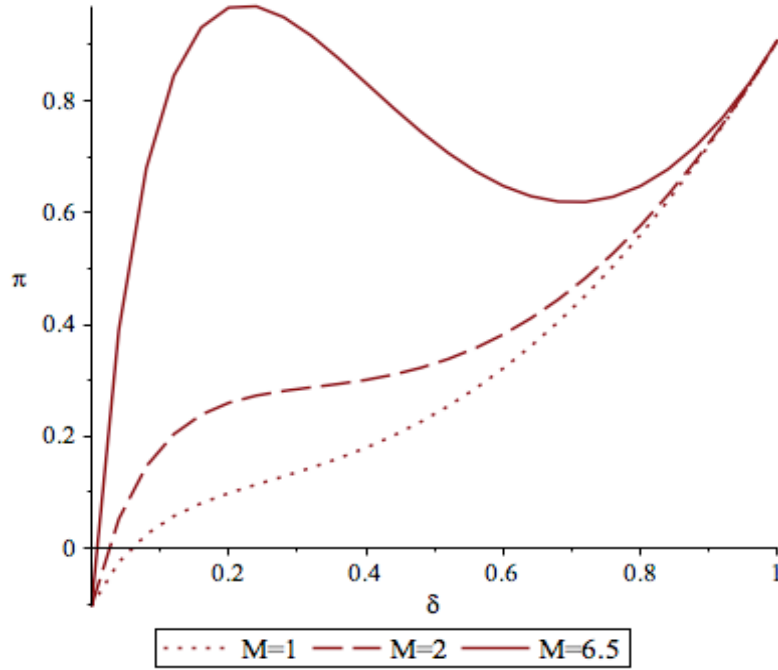


Figure 3.5. The choice of δ where $\bar{w} = 1/10$, $\sigma_y^2 = 1/5$, $X = 1$, $B = 1$

As it is indicated in Figure 3.4 and 3.5, in the presence of highly altruistic board, the PCRO uses both manager and the board if M is considerably higher than B . In addition, if σ_e^2

increases, as it is illustrated in Figure 3.5, the manager's input characteristics now should be even higher than in the case of figure 3.4 so the PCRO decides to share the decision-making task. In other words, the PCRO prefers to share the decision-making between the board of directors and manager if the manager's qualities are considerably higher than those of the board, otherwise the PCRO only use the board to make the investment decisions.

In the context of Hansmann's classification, the results in here suggest that if the board is vastly altruistic, the PCRO's governance structure will be a mix of mutual and entrepreneurial if the manager's quality of decision-making is higher than the directors. However, if this is not the case the PCRO will be classified just as a mutual entity.

The choice of δ in the presence of a self-centered board

Now a situation is considered in which the board only cares about itself and altruism does not play any role in board's incentives for exerting efforts in the process of decision-making.

In Figure 3.6 and 3.7 I take into account the case of selfish board in which $X = 1/100$. Similar to Figures 3.4 and 3.5 the choices of δ for two different values of σ_e^2 that are $1/10$ and $1/5$ are taken in to consideration respectively.

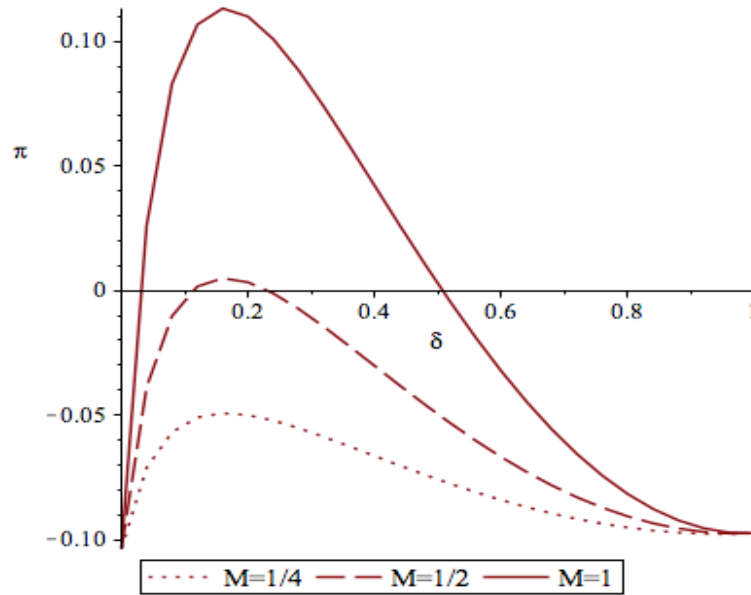


Figure 3.6. The choice of δ where $\bar{w} = 1/10$, $\sigma_e^2 = 1/10$, $X = 1/100$, $B = 1$

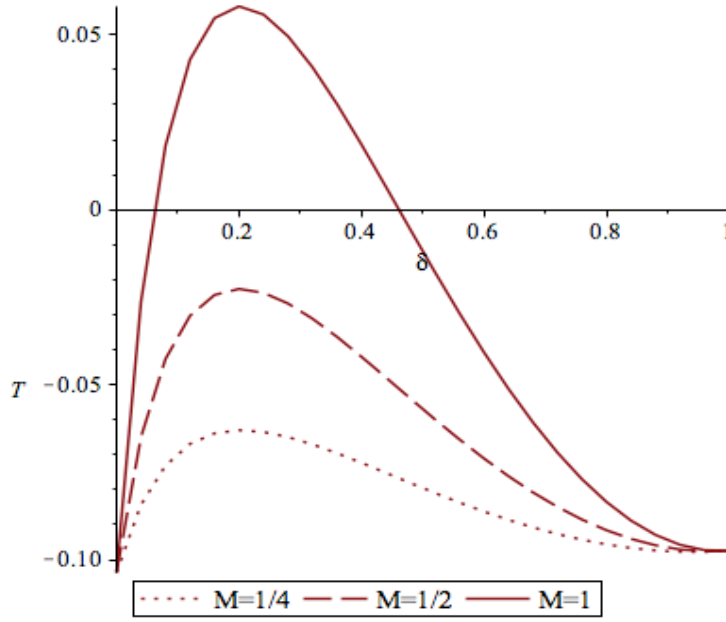


Figure 3.7. The choice of δ where $\bar{w} = 1/10$, $\sigma_e^2 = 1/10$, $X = 1/100$, $B = 1$

In Figures 3.6 and 3.7, if the board of directors does not much care about the rest of the industry, the PCRO is willing to share the decision-making between the board and the manager. In Figure 3.6, the PCRO shares the decision-making task even if M is half of B . However, in Figure 3.7, because σ_e^2 is two times larger than that of figure 3.6, the manager's input quality (including knowledge and cost of exerting efforts) should be close to that of the board. Therefore, in the presence of a non-altruistic board, the PCRO has to find a manager that is at least as good as the board.

To sum up we can now have an explanation about the conditions that may lead to the shared decision-making in PCROs. In other words the results of the theoretical model developed have implications about why PCROs adopt a governance structure that is a mix of donative-mutual and donative-entrepreneurial. In fact, the analytical analyses in this chapter suggest that factors incentivizing the controlling agents as well as the uncertainty embedded in the PCROs investment process may explain the mix status of PCROs.

Figure 3.8 summarizes the results of theoretical model in this chapter and helps us to present two hypotheses that are as follows:

H1: PCROs that use shared decision-making may not have frictionless measures of either managerial input or PCRO's output.

H2: PCROs that use shared decision-making may either have highly altruistic directors perceiving the managers to be more knowledgeable than the board members or their directors are not altruistic.

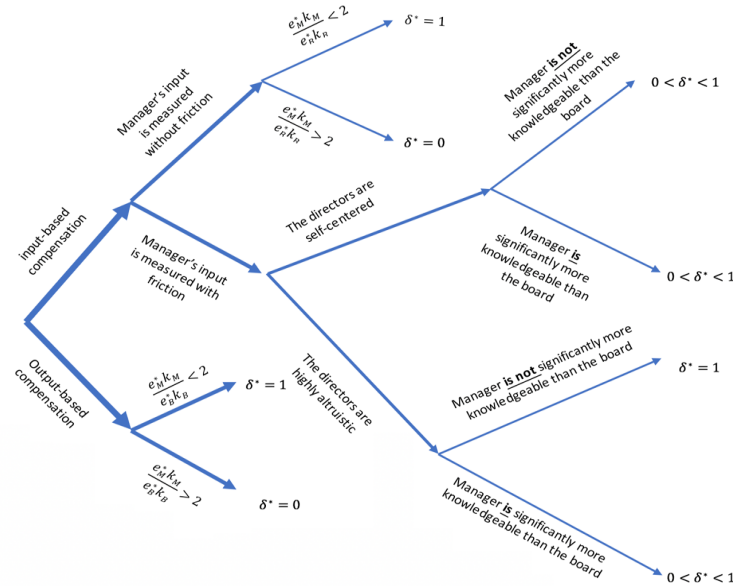


Figure 3.8. The theoretical models' implication for task assignment

3.6. Concluding remarks

Agency theory predicts the board of directors' involvement in the decision-making process of NP organizations is primarily limited to the oversight of managers' activities. However, in the course of conducting interviews with 14 PCROs it was observed the boards of

directors are not only in charge of monitoring of decisions made by managers, they are also involved in many stages of decision-making.

To examine the factors affecting the presence of board of directors in management decisions an analytical model was developed in which two agents can govern a PCRO whose objective is to maximize the return on investment in research and market promotion projects. The agents are the manager and the board of directors, where only the former is paid by the PCRO. Both agents combine their knowledge and efforts for making an investment decision. The PCRO faces two choices; 1) the weight that it has to assign to each agent in the decision-making process and 2) the payment scheme for the manager. Both of these decisions are made to maximize the returns on investments.

To consider the impact of different payment schemes on the choice of the task delegation, two cases were taken into account. In the cases of an output-based bonus, the results of the model suggested the PCRO decides to assign the task to either the almost perfectly incentivized manager or the board of directors, depending on their relative productivity. A separation of decision-making and oversight would exist in these cases over a range of plausible parameter values. In other words, the PCROs in this case will be either mutual or entrepreneurial organizations.

However, if the manager's input is the basis for his compensation, the PCRO has to use an evaluation method whose accuracy depends on the presence of a third party in the process of decision-making. In the model it is assumed the board of directors plays the role of the third party, where the weight of the board of directors' input in the decision-making process is positively associated with the accuracy of the manager's measure of input. In this situation, it is shown that the shared decision is more likely to be the norm if the board is not drastically altruistic. In addition, if the board is highly altruistic, the PCRO decides to share the decision-making if the manager has superior input quality (including knowledge or cost of exerting efforts) in comparison with the board. In these situations, the board of directors will generally also participate in order to incentivize managerial effort on one hand and help the PCRO to reach its objective on the other hand. In Hansmann's terminology, the results of the model implied that the PCROs could become a mix of mutual and entrepreneurial NP organizations based upon the factors incentivizing the controlling agents as well as the uncertainty embedded

in the PCROs investment process. Two hypotheses were developed based on the model's implications that will be more examined in chapter four of this dissertation.

The results of the model are naturally limited by the assumptions imposed on the model. The model assumed the boards of directors do not impose any costs on the organization. It also assumed the directors do not extract any rent from the organization. Furthermore, it assumed that the presence of manager and board of directors in the decision-making process are independent of each other⁷. Further work could relax the above assumptions to explore the PCROs' choice of delegation between board of directors and manager in different situations.

⁷ A possible, setup could be the use of Cobb-Douglass decision-making function. The results of the model for output-based compensation based on a Cobb-Douglass decision-making function is presented in Appendix B.

Chapter 4: Survey of directors of Saskatchewan Grain PCROs

4.1 Introduction

Every year, producer controlled research organizations (PCROs) in Australia, Canada, the United States and many other countries collect hundreds of millions of dollars from farmers to invest in R&D and market promotion projects. The investments made by these PCROs have had significant impacts on agriculture innovation and the stakeholders' well-being (Alston, Gray, & Bolek, 2012; Gray & Scott, 2003; GRDC, 2017). However, there is little information available about who makes the decisions in these entities and how. Motivated by the lack of the structured studies concerning the governance structure and decision-making process of PCROs, fourteen PCROs located in Australia, the U.S. and Canada were studied. In this process a series of interviews were conducted with managers and directors of these producer-led entities to gather information about their decision-making processes.

The analysis of interviews presented in Chapter 2 of this dissertation indicate that, except for GRDC in Australia, the board of directors of the PCROs studied are involved in both management and oversight tasks. The lack of separation in oversight and management assignments observed in the interviews is not consistent with most of the theoretical studies and empirical evidence evaluating the functions of the board of directors (Brown & Guo, 2010; Fama & Jensen, 1983; Miller-Millesen, 2003).

Among the literature describing the roles of the board of directors in the organizations, agency theory suggests an entity is supposed to assign management and oversight tasks to different agents. In the context of the agency theory and with the focus on the task delegation literature (Bester and Krämer 2008; Holmstrom and Milgrom 1991; Itoh 1994; Riordan and Sappington 1987) a theoretical model was developed in Chapter 3 of the dissertation explaining why a PCRO might assign the decision-making mission to the board of directors or manager.

The results of the theoretical model presented in the third chapter of this dissertation suggest that the choice to share the decision-making between the manager and board depends upon the compensation package offered to a manager. One of the main factors motivating the PCROs to share the decision-making task is compensating the manager based on a measure of

his input. Otherwise, if the outcome of the PCROs investments are used for rewarding the manager, depending upon the relative productivity of the board and the manager, the PCRO will be better off by assigning the task to just one of the agents.

The use of input-based compensation schemes originates from the presence of significant frictions in evaluating the outcomes of investments (Sappington, 1991). In the case of agricultural R&D projects, studies show the project results are usually realized several years after investments are made (Alston et al., 2011). Therefore, one can expect early measurement of outcomes of these investments to be difficult and measured with sizable variances. Consequently, a PCRO faces difficulties incentivizing its manager for exerting effort in the decision-making process. In light of these difficulties other tools for incentivizing the managers, such as input-based compensation schemes, could be used to motivate a manager

Accurate evaluation of the manager's input is only possible if there is a third party that in some way observes the manager's effort and expertise. In the theoretical model, the board of director's presence in the decision-making process improves the accuracy of the manager's input evaluation, by reducing the size of the variance of the measure. Moreover, the board members' characteristics such as knowledge levels or altruism might affect the choice of task delegation made by a PCRO.

Motivated by the implications of the theoretical model and the shared decision-making observed in the PCROs two hypotheses were developed in the chapter 3 of the dissertation. First, *observing shared decision-making suggests that PCROs may not have frictionless measures of either managerial input or PCRO's output*. Second, *the presence of shared decision-making implies that may either have highly altruistic directors perceiving the managers to be more knowledgeable than the board members or their directors are not altruistic*.

To examine these hypotheses, a follow-up survey was conducted whose participants are the directors of all (eight) grain PCROs within the Canadian province of Saskatchewan. The survey focuses on the PCROs of Saskatchewan, because I had faster and less costly access to their directors. In addition, I was well aware of these organizations' functions, which provided more accurate analysis of the board members' roles.

The survey included questions about the experiences of the participants both as farmers and directors. In total, 42 percent (22 out of 52) of the board members from these grain PCROs took part in the survey. To be able to analyze the differences between the directors and the

farmers electing the board members, the data available in a farm innovation survey conducted by Micheels and Nolan (2016) is used as well.

The result of the survey analyses suggest that, given observed shared decision-making; there are consistencies between hypotheses obtained from the theoretical model and task assignment of PCROs in Saskatchewan. In the case of first hypothesis, the directors' responses indicated the PCROs performances are difficult to measure and the returns on investments are not considered as the basis for managers' compensations. In addition, the respondents showed directors follow different methods to evaluate the managers' inputs. The differences in evaluation approaches imply the input performance measures are not frictionless.

Examining the second hypothesis, it was observed the directors are highly altruistic, while the management teams are more knowledgeable than the board of directors.

The remainder of this chapter is organized as follows: Section 2 reviews the results of the theoretical model and discusses the corresponding hypotheses. In Section 3 the outline and the characteristics of the survey are explained. The farming characteristics of the directors are presented in the Section 4. Section 5 provides discussions around the hypotheses and analyzes the results. Finally, Section 6 concludes and discusses this chapter.

4.2. Theories and hypotheses

The theoretical model developed in the previous chapter considers task assignment between the manager and the board of directors. The objective of the PCRO is to maximize the return on investment by assigning the decision-making authority to the board or manager. The manager and the board of directors are assumed to have different incentives for exerting efforts within the PCRO. The organization has to make two choices. First of all, it has to determine the weight assigned to agents' inputs and then the PCRO should specify the manager's reward.

Since agricultural research projects' results are usually realized several years after the investments are made (Alston et al., 2011), a measure of outcome may not be an effective tool to motivate the manager. However, when output can be measured, the results of the model suggest that PCROs prefer to assign the decision-making job to either the manager or the board of directors, but not both. In this case the delegation of the assignment depends upon the relative quality of the decision-making of the manager.

When the manager's compensation is based upon quality of input (i.e. efforts enhanced by knowledge), the PCRO uses an assessment mechanism contingent on the presence of a third party observing the manager's input. In the model this role is played by the board where its input weight in the decision-making process is directly associated with a proportional reduction in the friction of the manager's input performance measure. The results of the model, in this case, implied shared decision-making is likely to be the norm if the board is not very altruistic. However, if the board is overwhelmingly altruistic, the PCRO chooses to share the task if the quality of manager's input is meaningfully greater than the board. Furthermore, if there is no inherent friction in measuring the manager's performance regarding his input, the PCRO will decide to delegate the decision-making task to either the manager or the board.

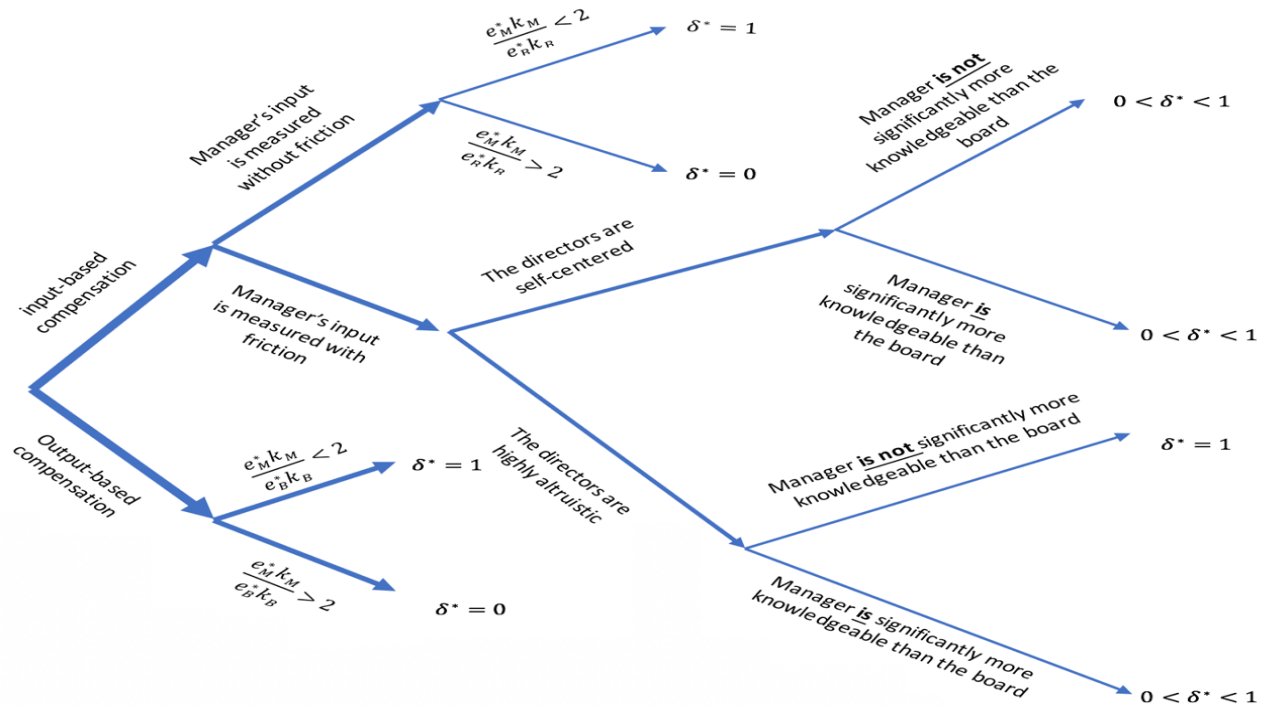


Figure 4.1. The theoretical models' implication for task assignment

Given the results of theoretical model, hypotheses no. 1 and 2 are as follows: *PCROs that use shared decision-making may not have frictionless measures of either managerial input or PCRO's output. PCROs that use shared decision-making may either have highly altruistic*

directors perceiving the managers to be more knowledgeable than the board members or their directors are not altruistic.

Examining the hypotheses, the directors of Saskatchewan grain PCROs are surveyed, considering the fact that we observed shared decision-making in the interviews. In the case of the first hypothesis, I asked two types of questions. I tried to find out how managers' performance is evaluated and then the directors answered questions regarding the methods by which the managers are compensated.

To examine the second hypothesis, the respondents' answers regarding the factors motivating them to exert efforts in the PCROs, as well as their perceptions about the management team's relative knowledge levels are taken into consideration. Examining the responses of survey participants, it will be discussed later in this chapter whether the first and the second hypothesis are consistent with governance mechanism of PCROs or not.

4.3 Survey Characteristics

The focus of the study is on Saskatchewan's grain PCROs that invest producer levies in research and market promotion projects related to different types of crops. These crops include pulses, wheat, barley, canola, flax, winter cereals, canary seed, and mustard. The Saskatchewan PCROs were chosen for the survey primarily due to the ease of accessibility. All of these organizations are located in Saskatoon and their meetings are held in this city. For instance, I could convince several directors to participate in the survey during the PCROs annual general meeting. In addition, focusing on one region could provide more consistent examination of the hypotheses, especially as I am more familiar with most of the PCROs in the regions and their managers and directors.

The survey questionnaire contained seventy-four semi-structured questions capturing information about the directors' experiences both as farmers and the PCROs' board members. The questions concerning the farming experience of the board members are borrowed from a recent farm innovation survey (Micheels and Nolan, 2016). Using farm innovation survey provides the opportunity to compare the characteristics of the larger population of farmers of Saskatchewan and the smaller subgroup of elected directors who are also farmers in this province.

4.3.1. The process of data collection

There are fifty-two directors serving as board members in eight grain PCROs within Saskatchewan. I began by sending forty emails to the directors, including the survey's cover letter and confidentiality agreement. I also attended the annual general meeting of some of these organizations and asked the directors whether they would take part in the survey. Several attempts were made to contact as many directors as possible via phone. In the end 22 board members were interviewed (42 percent participation rate). In twenty cases the interviews conducted via phone and two directors wanted to fill the survey by themselves. To encourage participation, an iPad Pro was awarded to one of the directors who participated in the survey, selected by random draw.

It took more than three weeks (January 6, 2017 to January 31, 2017) to conduct the interviews. The interviews ranged from 40 to 70 minutes long. After conducting seven interviews, it was decided to add a few questions and change the structure of some other questions. In the case of open questions, I took note of the directors' responses and before proceeding to the next question made sure their ideas were reflected accurately.

4.4 Comparing Farmers of Saskatchewan and directors of its PCROs

Using the data from farm innovation survey, this section compares farmers of Saskatchewan and directors of grain PCROs and their farming experiences. The farm innovation survey was conducted in 2013, among the farmers of three Canadian provinces: Alberta, Saskatchewan and Manitoba. However, a subsample of farm innovation survey participants is considered in here. The subsample used in the analyses includes farmers of Saskatchewan whose farm sizes are more than 600 acres and their farming activities include grain production. The rest of the farmers are excluded because there are farmers in the farm innovation survey whose farm sizes were small (e.g. less than 100 acres). In the sample of directors, the smallest farm size was 760 acres. Excluding small farm sizes in the sample allowed us to get more consistent comparisons. The farmers whose farming activities is limited to beef or dairy production are excluded as well, because the focus the study is on the directors of grain PCROs whose directors are supposed to produce the commodities the groups represent.

As indicated in Table 4.1, on average a director's farm size in the sample is 4117.86 acres, including owned and rented lands. However, the average farm size of farmers who work on more than 600 acres of land in Saskatchewan is 2401.92.

Testing the normality distribution for total land with the Shapiro-Wilk test (Shapiro & Wilk, 1965), the analyses indicates the normal distribution null hypothesis is rejected for both groups. Therefore, a non-parametric test was employed to compare two groups and see whether the distribution of their farm size is different or not.

Conducting the Mann-Whitney test it was observed that the mean rank for the non-director farmers in the case of the total land variable is 51.30 and for the board members is 77.77. Consequently, the Mann-Whitney U statistic is 522, Wilcoxon W statistic is 46.17, and the Z statistic is equal to -3.429 resulting in the 2-tailed asymptotic significance of 0.001 that rejects the null hypothesis. This suggests, in the case of farm size, directors are different than the rest of farmers in Saskatchewan.

Table 4.1. Directors' Farming Operation in comparison with Saskatchewan Farmers (total land>600 acres)

	<i>Directors' Net Total Land (Acres)</i>	<i>Saskatchewan Farmers' Net Total Land (Acres)</i>	<i>Directors' years At farm</i>	<i>Saskatchewan Farmers' Years at farm</i>
Mean	4117.86	2401.92	32.91	26.66
Number	22	90	22	90
Standard Deviation	3280.63	2668.01	11.05	16.653
Minimum	760	600	15	0
Maximum	13200	18000	50	75
Range	12440	17400	35	75
Skewness	1.08 (Std. Dev.: 0.491)	4.07 (Std. Dev.: 0.254)	0.103 (Std. Dev.: 0.491)	0.196 (Std. Dev.: 0.254)
Kurtosis	0.890 (Std. Dev.: 0.953)	20.492 (Std. Dev.: 0.439)	-1.482 (Std. Dev.: 0.953)	-0.439 (Std. Dev.: 0.503)

In addition, on average a director has managed his/her farm for 32.91 years while on average this figure for farmers of Saskatchewan with farm sizes of more than 600 acres is 26.66 years. About 64 percent of the board members stated that, in 2015 or 2016, they allocated more than 40 hours per week to their agricultural operation. This number is about 53 percent for the rest of farmers in Saskatchewan.

Approximately half of the directors in the sample achieved a bachelor degree or above and more than 27 percent of them have completed a technical or college diploma. However, the percentage of the directors with higher education is considerably greater than the total population of farmers in Saskatchewan. As indicated in figure 4.2, around 29 percent of the farmers have

bachelor or higher university degrees and only 24 percent of them have completed college or technical diploma. These numbers for the directors are 50 and 27 percent respectively.

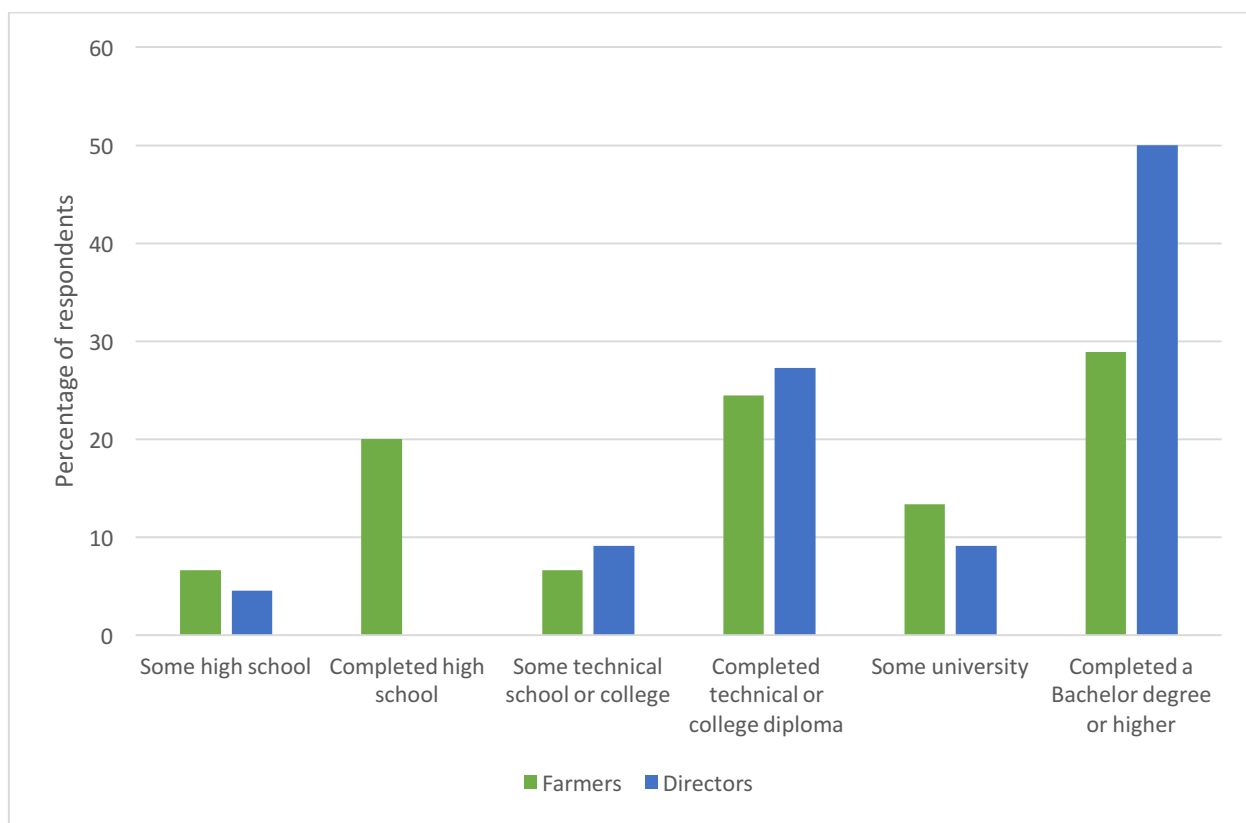


Figure 4.2. What is the highest level of education you have achieved?

Figure 4.3 illustrates the cumulative frequency graph of the directors and farmers' education levels. In general, one could see that directors are more educated than the rest of the farmers. For instance, more than 86 percent of the directors have at minimum a technical or college diploma while in the case of farmers this figure is 66.7 percent.

Therefore, as the directors on average are more educated and experienced than most other farmers, it could be said the directors are more likely to be prone to learning. In addition, considering these two characteristics of the directors, one could expect that the directors are expected to make more informed decisions in comparison with an average farmer.

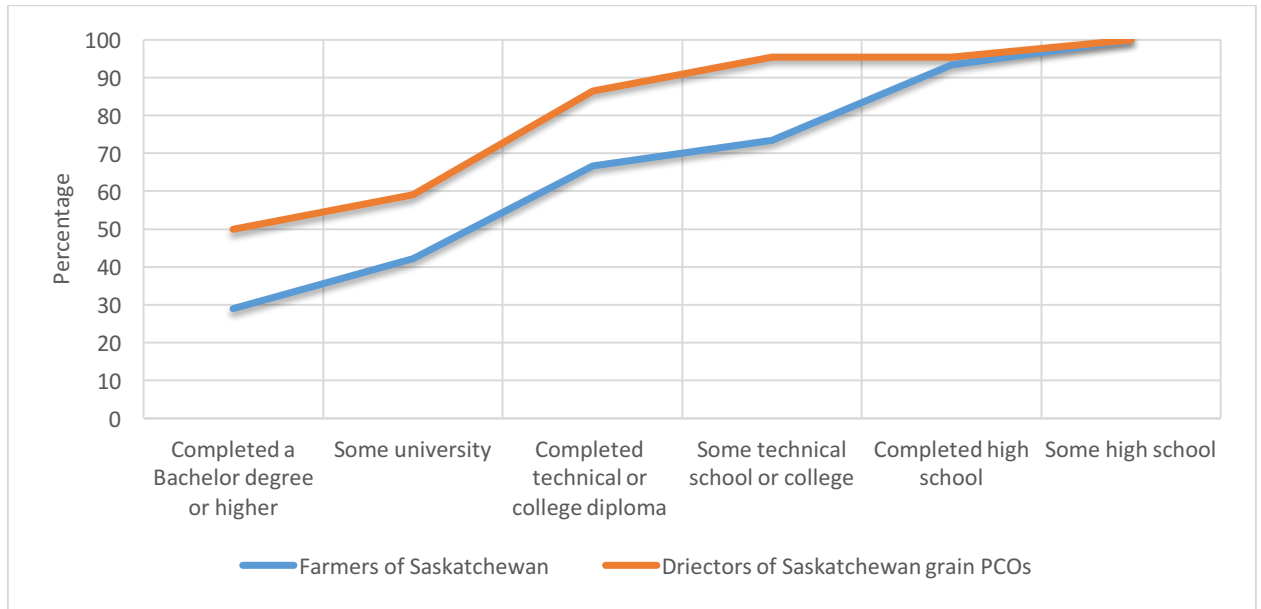


Figure 4.3. Percentage cumulative frequency graph of farmers and directors' education levels

4.4.2. Three most important farming goals amongst the directors and farmers

In the survey the directors were asked about the three most important goals in their farming businesses. The same question is also part of the farm innovation survey. The farmers and directors provided number of different answers. These answers were classified in three main categories: profitability, sustainability and growth.

The categories are considered based on the direct answers or the purpose of the goals provided. For instance, in the case of profitability, farmers and directors stated that their goals are running a profitable business (direct answer), to save for retirement, make a living, weed management, soil health and growing a good crop rotation. In these cases, it is suggested that these responses are related to the goal of running a profitable business. Moreover, the respondents provided similar answers in the case of different goals. This means there are responses in which the survey's participants told us their first most important goal is to make a living and in the same time their second most important goal is to grow good crop rotation, therefore based on the categorization, profitability shows up in more than one goal.

The responses related to sustainability and inter-generational succession is categorized into one category. In this case there are answers expressed more than once by some of the directors or farmers.

The third category denotes growth or expansion of the farm business. There were also few answers like “farming for fun” or “I like doing it” that were not included in any category.

Comparing the answers provided by the respondents of both surveys, one could observe profitability is the primary goal of most farmers and directors in their business. As well it seems this goal is more important for farmers in comparison with directors. The frequency of responses suggests that sustainability has higher value for the directors in contrast with farmers. Also, it seems that growth and expansion is very important for the board members in the sample, as the third most important goal in their farming business.

The higher frequency of responses referring to the sustainability and expansion amongst the directors, proportional to the farmers, could imply the board members in the sample have longer horizons in their farming business. Therefore, they are more likely to consider making investment decisions in the PCROs whose returns are realized in the long run.

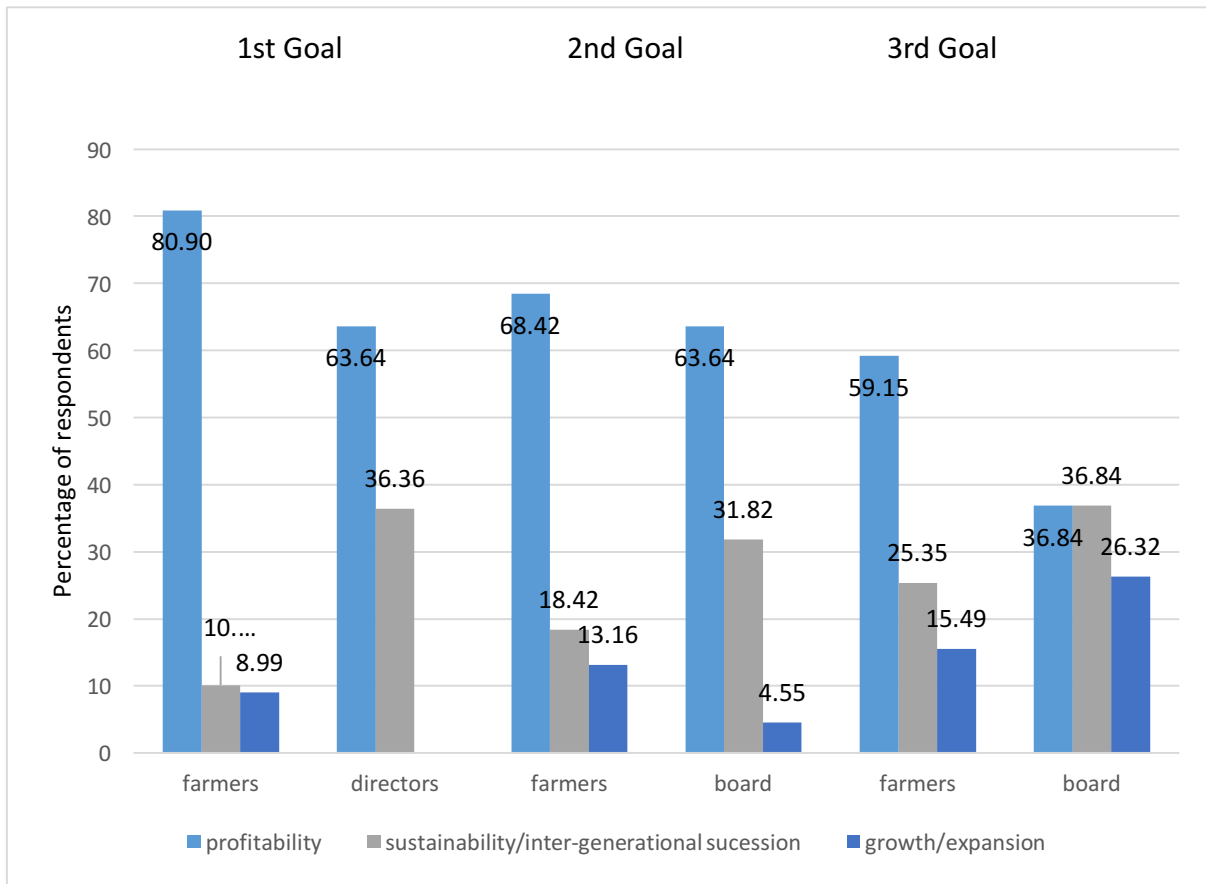


Figure 4.4 what are your three most important goals in your farm business.

4.5. Results:

Given the shared decision-making observed in Saskatchewan grain PCROs, two hypotheses are examined in this section. For each hypothesis, the responses corresponding to the components of hypotheses are taken into consideration and subsequently I will discuss the consistency of hypotheses with survey results.

4.5.1 Hypothesis 1:

PCROs that use shared decision-making may not have frictionless measures of either managerial input or PCRO's output.

Informed by the interviews presented in the second chapter of the dissertation, it would seem that the PCROs in Saskatchewan follow a shared decision-making process. The results of the survey also imply that the roles of board members of PCROs in the sample are not limited to oversight tasks — they are involved in managerial decision-making as well. Therefore, based on

the theoretical model results, it is expected that the managers of Saskatchewan PCROs are not compensated based on the outcome of the investments. On the other hand, if the managers' rewards are associated with their inputs in the PCROs, the measure of managers' contributions are evaluated by some frictions.

The involvement of directors in the PCROs

The directors and managers of PCROs who participated in the interviews stated that the directors are highly involved in the process of decision-making. In the survey of directors of Saskatchewan PCROs an attempt was made to gather more accurate information about the types and amount of efforts spent by the board members. The survey results indicate that more than 68 percent of the directors who participated in the survey have been the member of the research committee. As it is indicated in chapter two of this dissertation, the research committee has considerable influence in most of PCROs, regarding the final decisions made about research investments. This committee encompasses directors and staff and ranks the proposals sent to the PCROs. The board members also play important roles in determining the priorities and strategies of their corresponding PCROs.

In terms of quantity of efforts spent by the directors, the board members' responses show that, on average, half of the directors in the sample spend more than 25 hours a month for the organization activities inside the PCRO. Even director no. 2 stated that:

“This is not a fair question because from October 2015 till March 2016 I spent between 40 to 48 hours per month on organization activities”.

As indicated in figure 4.5, one can see that more than 70 percent of the directors allocated more than 15 hours per month on the organizations activities in the previous year⁸.

⁸ It was observed that the respondents that are the member of board of directors of smaller organizations, such as winter cereals, mustard and canary seed, are likely to spend less time on the organization's activities. These PCROs do not hire a full-time manager as well, because their levy revenue is proportionally lower than other organizations such as wheat, pulse and canola commissions.

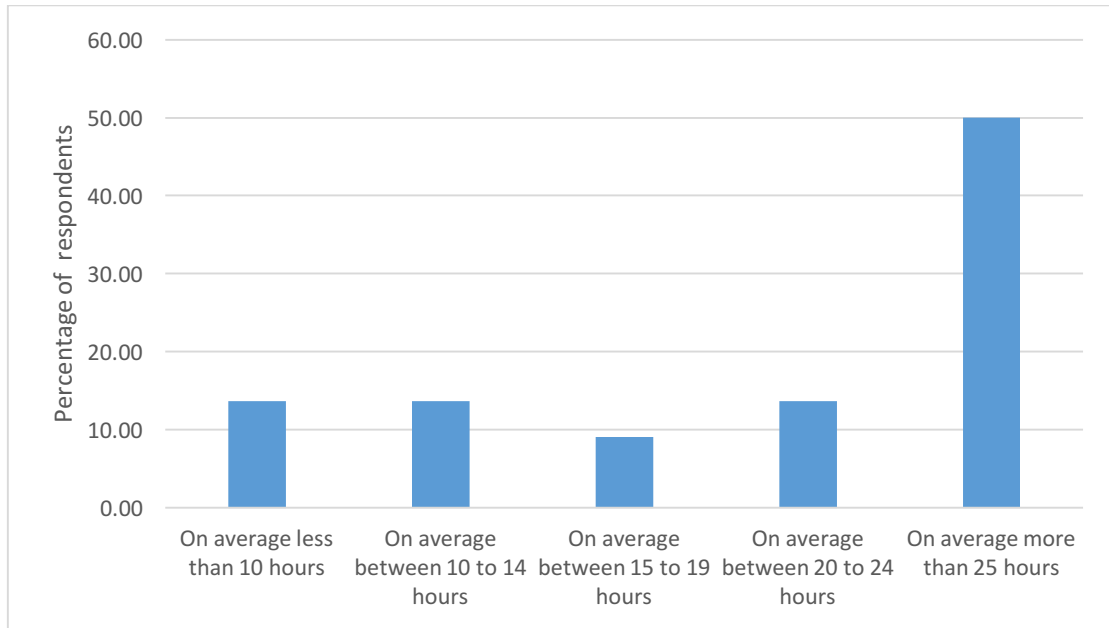


Figure 4.5. On average how many hours do you spend on organizations activities per month?

In addition, it seems that most of the directors are heavily involved with the PCROs activities, even outside of the organization’s formal activities. Around 90 percent of board members said they think about the organization’s affairs outside of the board meetings, at least once or several times per day.

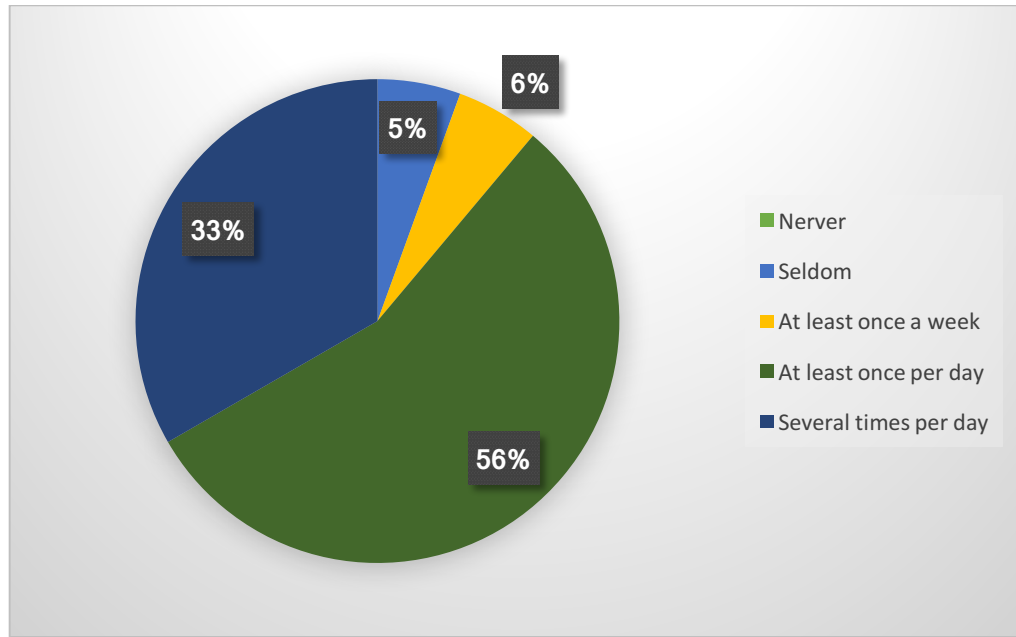


Figure 4.6. How often do you think about the organization affairs outside of the board meeting?

PCROs performance measure

The analyses of the responses show the directors do not have similar perceptions about the measure of the PCROs' performances. These differences seem to be related to the nature of agriculture R&D projects whose returns are realized after several years (Alston et al., 2011). In this case, some of the board members mentioned the difficulty in measuring the performances of the PCROs in terms of the specific numbers.

Examining the answers provided by board members suggest PCROs mostly rely on highly subjective measures. Out of eighteen responses received, ten directors (about 56 percent) mentioned they use strategic plans as basis for the organization's performance evaluation. Also the respondents indicated they use other measures to evaluate the performance of the PCROs investments. These measures include financial status, achievements of yearly objectives, survey of producers and levy refund ratios.

However, directors use both subjective and objective measures if they have to provide information about the PCRO's achievements to stakeholders. I asked the board members who participated in the survey "how do you respond to producers when they ask about value of investments made by the PCROs?"

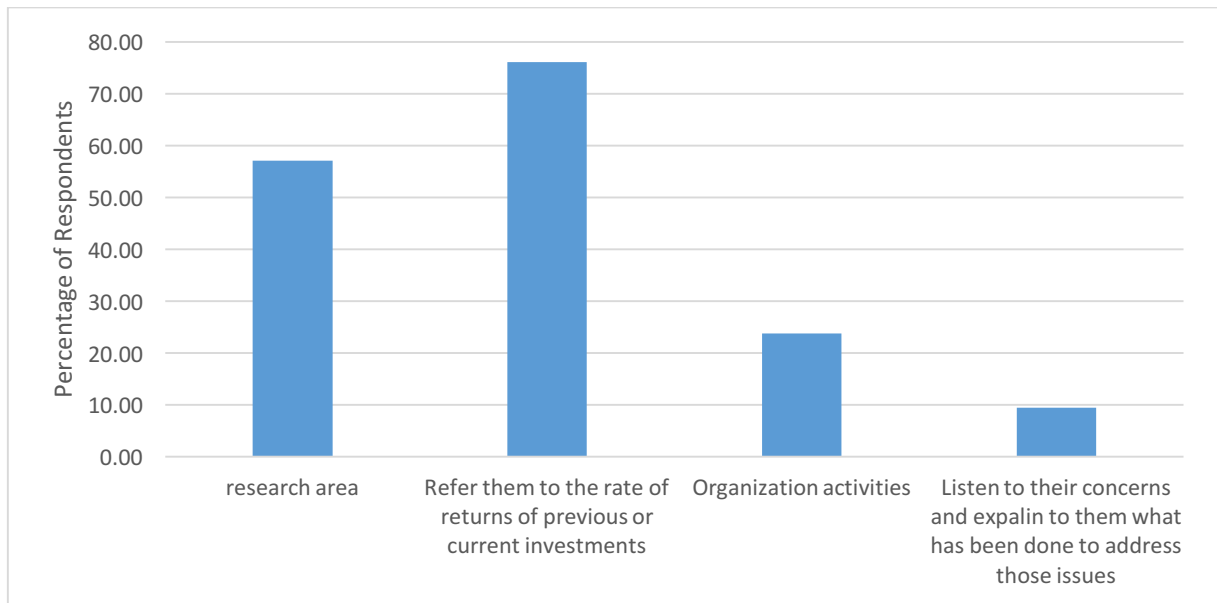


Figure 4.7. How do you respond to producers when they ask about value of investments made by the PCRO?

Although, several respondents told that they have not been asked such questions, based on the answers one can distinguish between three different types of information that a director might provide about the value of investments made within the PCROs.

More than 76 percent of respondent stated that they provide information about the rate of returns of the previous or current investments, to indicate investments in agriculture R&D result in notable return. However, PCROs in Saskatchewan infrequently rely on ex-ante cost/benefit analyses and the responses are primarily about the ex-post cost/benefit investigations.

In addition, more than 57 percent of the directors stated that they provide information about the type of investments made as well.

Around 24 percent of directors suggested that they would offer information about the organization activities such as the research organizations and researchers that work with the PCROs.

Therefore, it would seem there is more than one measure of performance used by the directors to evaluate Saskatchewan's PCROs. However, the examination of the responses implies there are no consistent perceptions of the measures amongst board members.

It also appears that the PCROs' performances are not easy to evaluate from the point of views of the directors. As illustrated in Figure 4.8, only around 55 percent of the directors in the sample clearly agreed that the outcomes of the organization investments could be measured with accuracy.

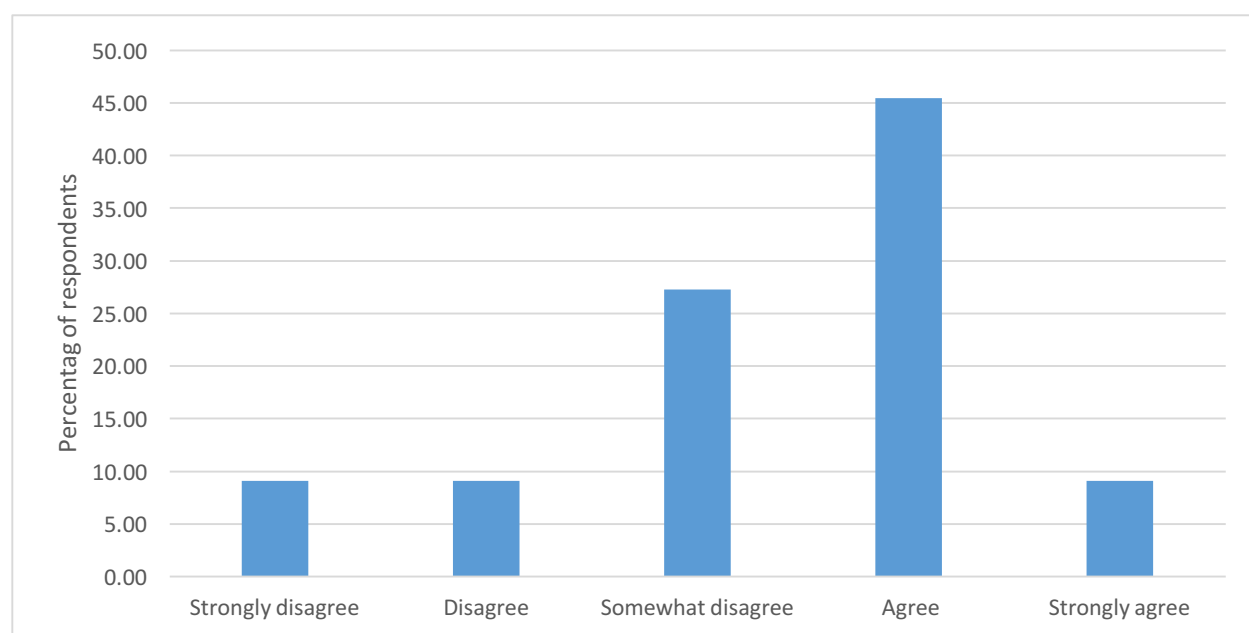


Figure 4.8. The outcomes of the organization investments can be measured with accuracy.

How are the management teams rewarded in Saskatchewan PCROs?

So far the analyses imply that there are discrepancies and significant variances in the performance evaluations of Saskatchewan PCROs. Therefore, as the theoretical model implies⁹, rewarding the managers based on the measure of output will not provide appropriate incentives for them. In this case, I asked directors who are in charge of management team evaluation whether they agree or disagree that the manager and staff compensation should be based on their contributions toward the returns on investment rather than their efforts and expertise. More than

⁹ The theoretical model suggests that in the case of output-based compensation scheme, manager's reward is negatively associated with the variance of the performance measure ($b^* = 1/(1 + \sigma_y^2)$)

95 percent of the directors did not agree that management teams' compensations should be based on their contributions towards the returns on investment.

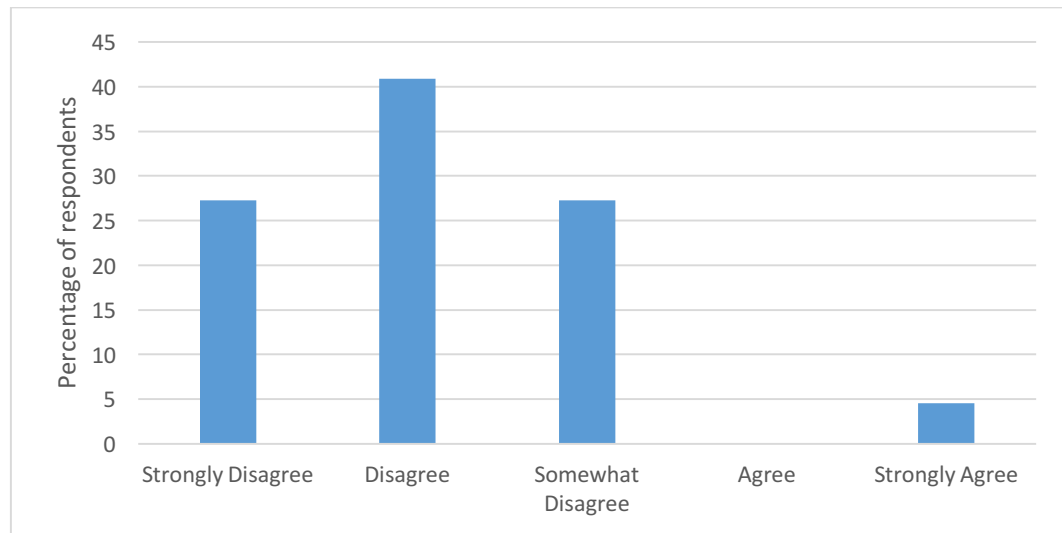


Figure 4.9. Should manager and staff compensation be based on their contributions toward the return on investments made, rather than their efforts and expertise?

As it indicated, a majority of the board members disagree with the use of output-based compensation plans. Therefore, efforts were made to gather additional information concerning the methods by which the directors evaluate the managers' performances.

First I asked respondents whether they are aware of manager and staff efforts for the PCROs. Around 73 percent of the respondents answered that they have very good knowledge of the manager and staff's efforts spent in the organizations. Then I asked the respondent to explain how they know the managers are good at their jobs. Examining the answers, I observed in the case of measuring inputs, the directors do not follow the same measures to evaluate manager inputs. More than 36 percent of the directors in the sample expressed that they can directly observe the manager's efforts and expertise. For instance, director no. 4 stated that:

"...The manager and staff's efforts are evident at each board meeting, each research committee meeting and the annual and semiannual meeting..."

Or director no. 13 indicated that:

"...By being with the manager we know what they are doing"

In addition, director no. 14 told us:

“I judge him with what he has done, I look at annual reviews, his plans and we look at the milestone and what he has done. I also get exposed to the manager by being involved. I also compare him with other people and we get the best manager in western Canada. He is very knowledgeable.”

The second most mentioned measure was the information provided by the manager to facilitate the board’s decision-making. In fact, more than 27 percent of the respondents in some way stated they consider how well a manager facilitates board decision-making by providing information for the directors. For example, director no. 1 said:

“I know if he is good at his job based on the knowledge that he brings to us for making investment decisions and he brings a lot”

Or director no 15 expressed that:

“Our CEO has a lots of contacts that really helps us to make informed decisions because of his background. He also helps us to make informed decision by bringing proposals forward...”

There are also other measures used by the board members to evaluate the manager’s performance, such as interaction with the board, pursuing and implementing the strategies set by the board, interaction with other PCROs, comparing with other PCROs’ managers and finally relying on the process in which the manager is hired.

To sum up, examining the directors’ responses, it was observed the PCROs’ performances are evaluated mostly based on subjective measures and with considerable frictions. However, the survey’s results imply that the PCROs do not tend to reward the management teams according to their contribution towards the return on investments.

Furthermore, the survey participants indicated they are well aware of the manager and staff’s efforts and expertise. The directors primarily evaluate the managers’ performances regarding their contribution towards making the decisions and not the outcomes of the decisions. However, the directors who are in charge of the managers’ performance evaluations assess the influence of the manager roles for making the decisions in different ways.

As a consequence, it is suggested there are some consistencies between the real work task assignment practice in Saskatchewan PCROs and hypothesis no. 1 stating that *“If shared*

decision making is observed, the manager's compensation package is based on neither the outcomes of PCRO's investments or a frictionless measurement of managerial input."

4.5.2. Hypothesis No 2:

PCROs that use shared decision-making may either have highly altruistic directors perceiving the managers to be more knowledgeable than the board members or their directors are not altruistic. Examining hypothesis no. 2, two types of information in this section will be provided, the factors motivating the directors for exerting efforts and relative knowledge of the management team to the board.

What factors motivate the directors?

First, I asked the directors to explain what motivated them to stand for election. Analyzing the survey participants' responses, the factors incentivizing the board members can be classified in three categories: altruism, personal gains and a combination of these two reasons.

More than 59 percent of the directors stated they nominated themselves in the election just for altruistic reasons. Half of the directors nominated themselves for altruistic purposes indicated that they were interested in serving other farmers. For instance, directors no. 18 said:

"I wanted to be at the service of industry. In fact, by being at the board you feel you have meaningful input for the industry"

Or director no. 4 who expressed:

"I seek to improve the profitability of farming specially for all farmers in Canada"

Some directors in this category are interested in becoming the voice of other farmers:

Director no. 3 said:

"I nominated myself because I wanted to represent the southern Saskatchewan farmers at the organization"

Board member number 19 stated:

"...I wanted to be in the organization because it could remedy the loss of wheat board. I also wanted to be the voice of the farmers."

Or director no. 20 told us:

“Because the government does not treat farmers fairly so I wanted to be the voice of farmers so they could have say and power”

Some board members who ran for the election just for altruistic purposes stated they wanted to pass on their experiences to others. Director no. 21 indicated that:

“I have experiences to offer. I also wanted to work with younger members to pay forward and pass the experiences for agriculture industry”

Also director no. 14 said:

“I ran for the election because I wanted to offer leadership to the farmers”

Two of the directors became board members because of requests they received from other directors. However, as they could simply reject the offers but did not, they can be classified as those who ran for the election because they care about others. For example, respondent no 9. Indicated that:

“I provided some agronomic services for another board member of the organization and he offered me to run because of my knowledge and I did”

On the other hand, there are some directors (18 percent) who nominated themselves just for the sake of personal gains. However, these gains are mostly in the form of non-monetary benefits such as learning or networking opportunities. For instance, director no.1 expressed that:

“I was interested to run for the election because I wanted to see what is going on in the industry as I am involved in the export of the crop”

Director no. 10 stated that:

“It was an opportunity for me to see the changes that happens in the industry and have my voice heard”

In addition, some other board members (23 percent) took part in the election for both personal gain and altruistic purposes. In this case, the personal gains that the directors are looking for are mostly in the form of learning and networking opportunities. Their altruistic agendas are in the form of serving others, passing on the experiences and representing other farmers. Below some of the directors’ responses classified in the third category are quoted:

“I ran to stay active at farm advocacy and mostly because of my interest in research”

Director no. 17

“I wanted to expand my knowledge base... also it is an opportunity for networking with other people... I also wanted to be involved in the industry”

Director no. 15

“I was unhappy with governance direction of the organization...besides I have strong interest of being involved with agricultural affairs and I am looking to expand my horizon”

Director no. 5

Investigating the motivations of the board members in the sample, one could suggest altruism is the most important reason motivating the directors of Saskatchewan PCROs. In fact, around 82 percent of the respondents sampled somehow mentioned they wanted to be a member of board of directors because of their interest in serving the industry. The second most important cause incentivizing the directors is learning and networking opportunities. The results of the survey show 32 percent of the respondents wanted to learn more about the industry or they wanted to expand their knowledge or connections.

The directors were also asked to provide their opinion about the fairness of board members' payments in the PCROs. More than 64 percent of the respondents believe the directors are paid fairly, proportional to their efforts. However, there is not a strong correlation between the reason behind running for election and the satisfaction of respondents with their payments. This is because some of the directors' agreements or disagreements with the fairness of the board members' compensation were not related to their attitude toward altruism. For instance, director no. 4 who said I somewhat disagree with the fairness of payments told us:

“I somewhat disagree because we are all paid 300 CAD per day while this is not fair for our chair as he puts much more effort than us”

Director no. 4

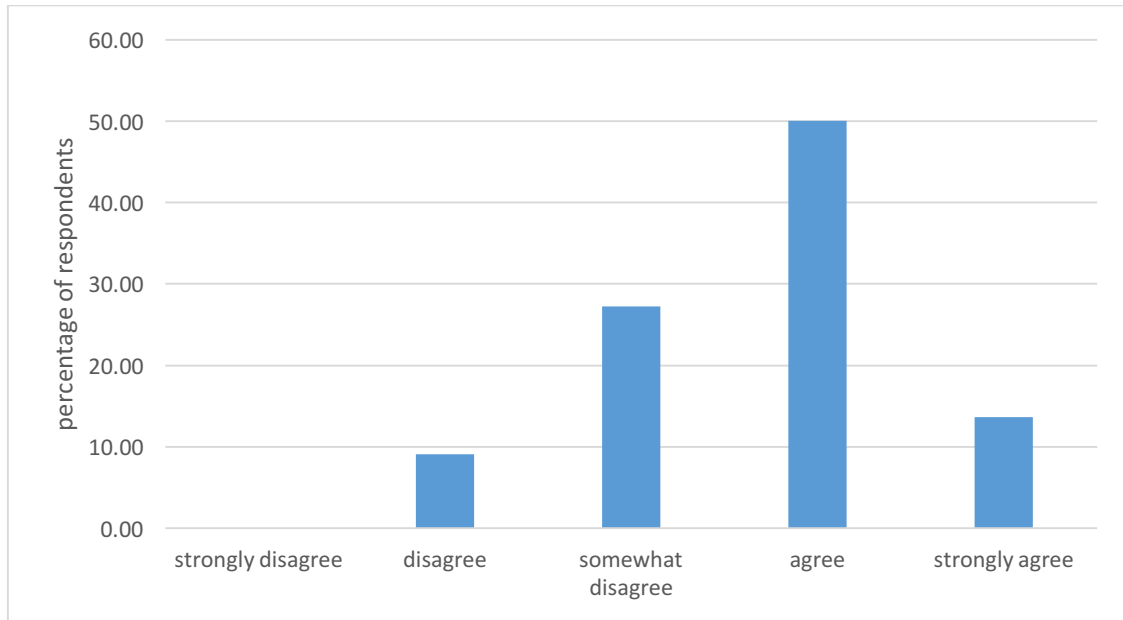


Figure 4.10. Directors are paid fairly proportional to their effort.

Directors no. 11 and 20 both mentioned board members have notable marginal costs for participating in the PCROs. However, the former director disagrees that the board members are paid fairly and the latter one agreed. In fact, respondent no. 20 who believes the directors are paid fairly stated that:

“There is no way that we can be paid fairly proportional to our effort as we could gain more at our farm, so I agree”

Given the presence of shared decision-making and dominance of altruism as a factor motivating the directors, according to the hypothesis no. 2, one can expect that the management team should be more knowledgeable than the board members. In this case, I asked the respondents to rate the relative knowledge of the managers and staff to the board members. More than 72 percent of the board members stated they think that manager and staff are more or much more knowledgeable than the directors.



Figure 4.11. How do you rate the relative knowledge of the manager and staff to that of the board?

To sum up, given the presence of shared decision-making observed, one can note the directors are highly altruistic and at the same time the management teams are more knowledgeable than the board of directors. Therefore, it is suggested there are consistencies between governance mechanism of Saskatchewan PCROs and hypothesis number 2.

4.6. Concluding Remarks

This chapter serves two purposes. It examines two hypotheses initiated from the theoretical model of chapter three and it reflects on some of the characteristics of the directors of PCROs in Saskatchewan and compare them with the larger population of farmers within the province.

In the first part of this chapter some of the characteristics of the board member with the farmers of Saskatchewan were compared. The results of the investigations indicated the directors on average have larger farm size; longer horizons, more farming experience and finally they are more educated than the rest of the farmers.

The second section briefly reviewed the results of this dissertation theoretical model and discussed the implications of the results and then presented two hypotheses stemming from the theoretical chapter. Following the results of the theoretical model presented in the previous chapter, two hypotheses were evaluated in this chapter. First hypothesis suggests that if the decision-making authority is shared between the board and manager, the manager's

compensation package is based on the measure of manager's input or this measure is accompanied with frictions. The second hypothesis implies that if a PCRO shares decision-making, the directors are not altruistic, or the directors are highly altruistic and the manager's relative knowledge level is greater than the board.

To examine these hypotheses, a follow-up survey was conducted whose participants are the directors of all (eight) grain PCROs of the province of Saskatchewan in Canada. The examination of the survey results suggested that, given observed shared decision-making, there are consistencies between the real world's task assignment practice of PCROs and the hypotheses extracted from the theoretical model. In the case of the first hypothesis, the directors' responses indicated the PCROs' performances are challenging to measure and the returns on investments are not considered as the basis for manager compensation. In addition, the respondents showed they use different approaches to evaluate the managers' efforts and expertise. The discrepancies in measures indicated the input performance measures are not frictionless.

Examining the second hypothesis, it was observed that the directors are highly altruistic and in the same time the management teams are more knowledgeable than the board of directors. Therefore, it is suggested that the theoretical model presented in the third chapter can explain the behavior of PCROs in their task assignment practices.

Chapter 5: Summary and Conclusions

5.1 Introduction

The goal of this dissertation was to explore decision-making process and governance structure of PCROs, with the objective of creating public knowledge that can improve the PCROs governance. The organizations investigated in this dissertation are different than agricultural cooperatives and agricultural producers associations in which farmers are present at directors. PCROs are different than cooperatives because as we explain later PCROs have the non-distribution constraint and considered as NP organizations. The PCROs do not have any residual claimants, as the shares are not defined in these entities. However, cooperatives distribute their profits amongst their members (Hansmann 1980). The PCROs should be also distinguished from the agricultural producer associations that are NP organizations by nature. This is because the PCOs are typically granted taxing power by governments while agricultural producer associations, as NP organizations, do not have such a power. Furthermore, the PCROs are specially tasked with investing farmers' checkoff in agricultural R&D and promotion projects, while the tasks of agricultural cooperatives and agricultural producer associations include a wide range of activities including marketing, advocacy, distribution and so on.

To meet the objective of the study, case study methodologies were used similar to those employed by Eisenhardt (1989), Eisenhardt and Graebner (2007) and Siggelkow (2007). The study revealed the differences and similarities amongst these entities governance and decision-making process. Consequently, given the existing theories and literature, the study tried to provide theoretical explanations of PCROs' governance structure. Finally, this doctoral dissertation checked for consistency between the theoretical results and the governance of PCROs, by exploring whether two hypotheses derived from the theoretical model were consistent with observation.

Interviews were conducted with managers and directors of several key PCROs across Canada, Australia and the U.S. to examine the decision-making process of these producer-led organizations. Among several interesting results, interviews revealed that with the exception GRDC in Australia, the rest of PCROs involved their board members in the management

decisions. This observation is in contrast with the general task assignment practices of NP and FP enterprises. A model based on agency theory was developed in this doctoral dissertation to explain the unusual task delegation practice of PCROs. Two hypotheses were derived from the outcomes of the theoretical model. The fourth chapter of the dissertation reports the results of the hypotheses examinations with the use of data collected in a survey of all the grain PCROs in the Canadian province of Saskatchewan.

The results of the research conducted in this dissertation have several contributions: 1) it fills a gap in the literature related to the governance of PCROs by providing an extensive examination of these organizations decision-making process and governance structures. 2) It provides a theoretical explanation regarding the nature of PCROs' functions in the context of NP organizations literature, 3) the study reveals an apparent anomaly in the governance of PCROs by showing that the oversight and management tasks are not separated in these producer-led entities, 4) it provides the best management practices that can be used by PCROs to improve their governance and decision-making, 5) it provides a theoretical explanation regarding the lack of separation between oversight and management in the PCROs and expands the theory developed by Hansmann (1980) regarding the presence of patrons in controlling of NP organizations, 6) it contributes to the task delegation literature by incorporating the impact of long investment horizons, the output versus inputs performance measures and collective incentives into the task assignment model, 7) the study provides basis for further investigations of the NP and FP organizations in which the return on investments are accompanied with great deal of delay and uncertainty, 8) finally the study provides empirical support for the implications of the theory developed by emphasizing on the importance of the performance measures based on the input of the managers, altruism of directors and relative knowledge of agents involved in decision-making of PCROs.

5.2. The conclusion of study

A synopsis of the three studies conducted to meet the objectives of this doctoral dissertation is presented below.

5.2.1. Research allocation decision-making in PCROs

A series of interviews with managers and directors of some of key PCROs in Canada, Australia and the U.S. were conducted to gather information about the governance and decision-

making in PCROs. The analyses of interviews, presented in Chapter 2 of this dissertation, revealed important information about some features of PCROs: 1) PCROs are NP organizations with non-distribution constraint, 2) farmers and professional managers are both involved in making investment decision of PCROs implying that these organizations are primarily a mix of donative-mutual and donative-entrepreneurial based on Hansmann (1980)'s classification of NP enterprises, 3) one can distinguish between five stages of decision-making in the research decision-making of PCROs: i) determination of priorities, ii) request for proposals (RFP), iii) review and ranking of proposals, iv) measuring performance and v) finally collecting grower feedback and information about their research interests, 4) scoring is the primary method of project ranking in most PCROs while cost-benefit analysis or internal rate of return is seldom used. 5) the directors of PCROs sampled are highly involved in the management decision implying that these producer-led entities do not tend to separate oversight and management.

5.2.2. Task assignment in producer controlled research organization, a theoretical explanation

The study presented in Chapter 2 revealed that PCROs do not separate oversight and management. Thus, a theoretical model based on the agency theory was developed to explain this unusual task assignment. The model presented in Chapter 3 of this dissertation considers a PCRO that must delegate the share of decision-making power to the manager and the board of directors, with the objective of maximizing return to producers. Motivated by interviews and strands of literature the model incorporates several factors into the task delegation of the PCRO. The factors include: characteristics of the board of directors (i.e. share of the industry, attitude toward altruism and learning capacity), the relative knowledge levels of the manager and board members, and the ability to incentivize the effort of the manager based on imperfectly-measured output or decision-making input. The results imply that managers tend to be imperfectly incentivized, because output can only be measured with long lags and uncertainty, and input measurement requires monitoring. Board members, on the other hand, can be less knowledgeable, but can be highly motivated by vested interest in outcomes, altruism and learning opportunities.

In the special case of an output-based bonus, a separation of decision-making and oversight would exist, and the PCRO will assign the task to either a perfectly incentivized manager or the board of directors. When output cannot be measured and the manager's reward must be based on

his/her observed input, shared decision is more likely to be the norm. If the board is highly altruistic, it will be optimal for the PCRO to share the decision-making if the manager's input qualities, including his knowledge level or cost of exerting efforts, are superior. In these situations, the board of directors will generally also participate in order to both incentivize managerial effort and help the PCRO to reach its objectives.

5.2.3. Task assignment in the PCROs, an empirical examination

Chapter 4 of this dissertation examined two hypotheses derived from the theoretical model of Chapter 3. The first hypothesis states that; *PCROs that use shared decision-making may not have frictionless measures of either managerial input or PCRO's output*. The second hypothesis states that; *PCROs that use shared decision-making may either have highly altruistic directors perceiving the managers to be more knowledgeable than the board members or their directors are not altruistic*.

To examine these hypotheses a survey of board member from (eight) grain PCROs within the Canadian province of Saskatchewan was conducted. The results of another survey, called the farm innovation survey (Micheels and Nolan, 2016) was used to provide a comparison between directors of PCROs and the farmers of Saskatchewan. In general, it was observed that directors on average have larger farm size; longer horizons, more farming experience and finally they are more educated than the rest of the farmers.

The examination of the survey results suggested that, given observed shared decision-making, there are consistencies between the task assignment practice of PCROs and the hypotheses derived from the theoretical model. In the case of first hypothesis, the directors' responses indicated the PCRO performance is challenging to measure and the return on investments are not considered as the basis for manager compensation. In addition, the respondents showed they use different approaches to evaluate the managers' efforts and expertise. The discrepancies and variability in the measures indicated the input performance measures are not frictionless.

Examining the second hypothesis it was observed that the directors are highly altruistic and in the same time the management teams are perceived to be more knowledgeable than the board of directors. While these small samples rule out any definitive statistical tests, the consistency between the hypothesis derived from the theoretical model and the observation provides some support for the theoretical model.

5.3. Implications of the study

The following section presents the implications derived from this doctoral dissertation for the PCROs, implications for other organizations and policy makers.

5.3.1. Implications for PCROs

1) The PCROs are unique entities that do not separate between management and oversight. The current governance structure of PCROs seems to be inevitable for two reasons: 1) the outcomes of investments are not observable in the short-run and 2) the directors benefit from their involvements in the process of decision-making. Therefore, it seems that there is a rationale behind the choice of shared decision-making in these organizations. Hence, it is suggested that the PCROs should continue to follow their current mode of decision-making. Amongst the PCROs sampled, GRDC is the only organization in which management and oversight are separated. However, this entity spends a considerable portion of its resources to identify the outcomes of the investments made. This organization commissions ex-post benefit/cost analyses, provides annual survey of growers to evaluate producers' insights and reactions to investments made, it provides a survey of research partners to make sure the connections between research and GRDC are on the right tracks and there are extensive measures used to examine the proposals validity and projects advancements. Therefore, it seems that the separation of management and oversight is a feasible governance mode that could be used in large PCROs.

2) The results of the study show that board members' altruism and knowledge levels are important contributions to the success of PCROs. This implies that resources spent on recruitment, training and retention will play long-term dividends for producers supporting the PCROs.

3) Without exception, all the PCROs in the sample engage producers in the processes of decision-making. In this case, one can distinguish between two decision-making modes that are bottom-up and top-down process. In the top-down mode, the directors representing the producers determine the priorities, strategies and investments' directions. These guidelines determine the investments direction of the PCROs and its future performance. In the bottom-up method mostly used by GRDC in Australia, the producers get involved in the process at the lower levels of decision-making and their interests are reflected in bottom-up mode. However,

in several cases the organizations started to use a combination of bottom-up and top-down methods. For instance, in the case of GRDC it was observed that, RCSNs and GSGs are two new entities encompassing farmers and other agricultural sector stakeholders, that not only transfer the regional problems to higher levels of decision-making, but also have authority and resources to invest in a set of projects related to their regions.

This feature of the PCROs seems to be a best practice. However, the PCROs might want to consider decision-making where the top-down and bottom-up modes of decision-making are in a balance.

4) PCROs primarily rely on subjective measures for making investment decisions and scoring methods are used to rank the projects. However, several studies that have examined these methods (Alston et al., 1995; Pannell, 2015; Pannell & Gibson, 2014) show that overlooking economic theories and overweighting the subjective measures in the choice of the projects could result in considerable loss of the resource. Thus, it is suggested that the PCROs could benefit by relying more on economic-based decision-making tools such as internal rate of return or benefit/cost analysis.

5.3.2. Implications for other organizations

These results of this doctoral research indicate that there are situations in which the separation of oversight and management decisions may not be feasible or even desirable. This is especially the case when the outcomes of an organization's investments are measured with great deal of delay or uncertainty. The theory and discussions provided in this study are consistent with the behavior of VCs in start-up companies documented in the literature. Several studies show that VCs look for higher levels of control in start-ups in which the returns on investments are accompanied with great deal of uncertainty. Thus, this dissertation demonstrates that there may be exceptions to the best practice of separating oversight and management.

5.3.3. Policy implications

The government, market and contract failures in agricultural research investments are three reasons behind the establishment of PCROs. The PCROs and NP organizations complement public and private sectors in agricultural research investments. The results of this study imply that the lack of separation between management and oversight in PCROs seems to be necessary for these organizations to be able to correct for the government, market and contract failures.

The unusual task assignment of PCROs helps these producer-led entities to accomplish their mission in provision of industry good. However, there are factors that could result in the failure of these organizations to invest sufficiently and efficiently in agricultural research. These factors include: difference in producers' innovativeness, agency problem due to difference in the interests of decisions makers (Alston & Fulton, 2012), institutional lock-in (Froystad, 2012), high rate of spillovers and negative attitudes of producers about the effectiveness of PCROs' investments due to long investment horizon of these organizations (Gray, 2014). Therefore, it is suggested that the policy makers might cooperate with these organizations to reduce the negative impacts of aforementioned factors.

5.4. Future research

This study has addressed a gap in the literature regarding the governance structure and decision-making of PCROs and it can be used to provide a basis for research in future.

This study is one of the first attempts to systematically study the decision-making and governance of PCROs. As such it employed a case study approach and confined the scope of study to 14 grain-based PCROs in three countries. A natural extension of this research would be to expand the research to other countries and other agricultural commodities. If it was possible to create a large enough data set some of the theory developed in this dissertation could be explored with more formal statistical tests of inference.

While this study primarily focuses on the internal affairs of PCROs, most of the PCROs collaborated with other PCROs particularly in jointly funding research. Future study could examine these interrelationships to gain a better understanding the role they play in decision-making.

The researchers funded by PCROs often closely collaborate with PCROs in the decision-making. In particular, the use of subjective measures to rank the projects could potentially raise agency problem between PCROs as principals and researchers as agents.

Future studies could also explore the organizations in other industries that are in charge of producing industry goods. As a start it would be useful explore to what extent to similar organizations exist in other industries and if they exist how do they make decisions. If they do not exist, is there scope to model their creation from the success in agriculture.

Another interesting topic that could be taken into consideration in the future is study of entities in private and public sectors that do not tend to separate between oversight and management. In particular, the insights provided in this study could be used to find out whether the lack of separation in other organizations is related to the implications of this study, or not.

There exists a rich literature related to the characteristics of directors of NP and FP organizations and their influence on the performance of organizations. However, there is no such study related to the PCROs. Hence, using the insights provided by this dissertation, future studies could specifically focus on such a topic.

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Appendix A: The list of organization sampled

GFO	Grain Farmers of Ontario
GRDC	Grain Research and Development Corporations
MCG	Manitoba Canola Growers
SCDC	Saskatchewan Canola Development Commission
SFDC	Saskatchewan Flax Development Commission
SPG	Saskatchewan Pulse Growers
SWDC	Saskatchewan Wheat Development Commission
KWC	Kansas Wheat Commission
USB	United Soybean Board
WGRF	Western Grain Research Foundation
MWBC	Montana Wheat and Barley Committee
ICPB	Iowa Corn Promotion Board
ISCP	Iowa Soybean Checkoff Program
AWDC	Alberta Wheat Development Commission

Appendix B. Governance structure and decision-making process of 10 agriculture PCROs

Organization	Relationship With private and public organizations	Governance structure and Board appointment	Request For Proposals	Decision-making process	Performance measures	Mechanisms to collect farmer's feedbacks and research interests.
WGRF (Canada) Revenue in 2014: Total: 30,014,642 Checkoff 8,604,323 Crops: Wheat, barley, canola, pulses and so on. However, the main focus is on wheat and barley respectively. Investment portfolio: -Variety development	WGRF does not invest in the research areas that are of interest of private sector. It also usually collaborates with public entities such as universities or government research organizations.	WGRF is a membership -based organization such that board of directors represents 18 PCROs or associations as the members of this organization .	WGRF does not have call for proposal, instead it uses three annual call by ADF in Saskatchewan, AFC in Alberta and ARDI in Manitoba. Occasionally it contributes to Genome Canada funding. Also it is involved in co-funding with other organization-	Three main bodies are involved in the process of decision-making including: board of directors, research committee and staffs. In the first step, WGRF receives the titles of LOIs sent to ADF, AFC and ARDI. WGRF's staffs review the titles and ask for the full LOIs expected to have high values. In the next step, research committee comprised of four board members and five to seven experts reviews the LOIs. The reviews are conducted in three areas that are: variety development, production and post-production. In general, the research committee is in charge of reviewing LOIs and proposals and recommendation to board for final decisions. In this step the research committee reviews the LOIs based on three criteria: scientific	For individual projects, WGRF asks for annual progress and final reports reviewed by the staff. In the presence of co-funding, WGRF accepts the reports received by funding partners. Another performance measure for individual research is the number of presentations of	There are three sources by which WGRF find out about farmers' investment interests: 1- inputs of board members. 2- interaction with other organizations 3- reports and researches addressing the gaps in the agriculture.

-Production (agronomy) -Post-production			on.	<p>merit, potential impact on producers and likelihood of success. The research committee asks for full proposals of those LOIs that passed the second steps' filters.</p> <p>In this step research committee reviews the proposals based on the three criteria mentioned in the second step. However, in this stage, each committee member individually ranks the three criteria by A, B, C and D where A refers too best and D to the worst. In this process there are also discussions among the member of the research committee. Finally, the research committee ranks the criteria based on consensus and if one of the criteria is ranked C or D, the proposal will not be recommended to the board of directors for a final decision.</p> <p>At the final step the board of directors make final decisions to fund a proposal or not and this decision is usually based upon the recommendation of research committee. In this stage the staff of WGRF communicate with other funding organizations to find out about co-funding opportunities.</p>	<p>publications for each project. WGRF does not measure its general performance on a regular basis.</p>	
GRDC Australia Revenue:	GRDC is highly involved in	There are four main bodies of	GRCD calls for tenders through which	The process of decision-making in GRDC includes six steps and is mostly a bottom-up process. The main steps	GRDC uses several methods to evaluate its	GRDC uses several sources to identify the

<p>GRDC's investments are funded by levies and Australian government contribution and royalty income. Farmers pay a 1% levy to the GRDC if they produce any of 25 different crops including wheat, coarse grains, pulses and oilseeds. The Australian government contributes to GRDC funding by paying 0.5 percent of the three-year average of the 25 crops' gross values. Total revenue in 2015: 196 million AUD including 69.1 million from Australian government and</p>	<p>collaboration with public and private organizations. Government appoints GRDC's boards. The government funds about 30% of GRDC's budget as well. Furthermore, GRDC's investments are highly affected by the priorities of the Australian Government. On the other hand, GRDC has considerable collaborations with both universities and private research companies in the form of co-funding of</p>	<p>decision-making in GRDC. The Board of directors is the most important body and it is in charge of governances, setting strategies and performance monitoring. Australian government based on board resume and recommendations of growers and other industry stakeholders appoints GRDC's directors. Panels: it comprises both</p>	<p>research providers submit their proposals. GRDC usually is more interested in collaborative funding of projects; therefore, based on the results of decisions made in the investment weeks, proposals are chosen for funding. If a researcher independently proposes a research project GRDC develops a request for proposal to solicit competitive bids for the topic. If there are</p>	<p>of decision-making in GRDC are summarized as follows: Priority identification: Regional panels collect information about the regional and national issues through communication with growers, industry representatives and Regional Cropping Solution Networks (RCSNs). In this process, RCSNs and regional panels play important roles. There are nine RCSN in Southern and Western Australia. The southern region is divided into four zones based upon the amount of precipitation: high, medium and low rainfall zones and irrigation zone. The western region is divided into five "port zones" including Geraldton, Kwinana West, Kwinana East Esperance and Albany. RCSNs were created over the past three years to provide information related to problems and priorities in their regions. Growers, agribusiness owners and researchers in each zone are the members of RCSNs. They meet on a regular basis to discuss the main issues and demands for R&D investments. For instance, 36 priorities were identified in Southern RCSNs during 2013-2014 resulting in GRDC making new investments in 17 areas and further issues were addressed by increasing investments in ongoing</p>	<p>performance. In the project level GRDC uses annual progress reports and final reports. In addition, for some of the projects GRDC commissions external experts to evaluate the economic impact of investments in project levels. In addition, GRDC conducts surveys among farmers and research partners. Farmers' surveys are especially used to figure out whether the projects conducted benefited the growers or not. The research</p>	<p>research interests. These sources are: Regional panels, RCSN, growers' surveys, research partners' surveys and researchers' ideas.</p>
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<p>113.4 million dollar of checkoff revenue. Investment themes:</p> <ul style="list-style-type: none"> -Crop yield improvement, - Market development, - Crop protection, -Farm resources base improvement, - Building skills and capacity and -Advancing profitable farming systems 	<p>projects.</p>	<p>regional and national levels panels. There are three regional panels that are northern, southern and western regional panels. They are in charge of identification of regional and national issues, determination of priorities, interacting with growers and informing them about GRDC's plans and achievements. Regional</p>	<p>issues related to intellectual property rights or lack of experts to bid on the proposals, GRDC will engage in direct negotiations with the research providers. According to GRDC, about 50 percent of investments per year are made through direct negotiations while the remaining half is funded through the tendering process.</p>	<p>projects. Regional panels analyze the information, set the regional priorities, and identify investment demands for R&D. Using the analysis of regional panels and other information collected through different reports and communications, national panels provide advice for the board to set the strategies and investment themes. In this stage, Australian government priorities are taken into account as well. Investment planning week: Regional panel members and GRDC's managers meet in July or August for further discussions about priorities and investment gaps. Based on the analysis of information during the first and second step, GRDC managers make decisions regarding budget allocations between investment themes. In this stage, board and regional panel consultations play important roles. After discussions regarding GRDC budget allocations between investment themes, managers provide proposals for needed R&D investments. The regional panels and GRDC managers rank the proposals. Based on the rankings, the national panel provides recommendations to the board with a final resource allocation plan.</p>	<p>partners' surveys are conducted to provide information about the effectiveness of GRDC's relationships with its partners and they are used to solve possible problems in GRDC's operations. GRDC also provide annual operational plans in which it provides measures of its performances in achieving the expected outcomes of investment themes and strategies. These measures are based on several reports and surveys</p>	
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		<p>panels' reports to the board through national panel.</p> <p>The Senior Leadership Group: that includes the managing directors and business groups managers.</p> <p>Business Groups: This is composed of four groups managing GRDC's activities.</p>		<p>In the fourth step, GRDC calls for proposals based on the investment priorities. These priorities determine what the issues should be addressed and how they are related to five and ten year strategies.</p> <p>As the priorities and expected outcomes are determined Each priority has evaluation team including members of regional plans, managers of GRDC and consultants.</p> <p>The teams evaluate the applications based on seven criteria. In fact, the applicants should provide information about extent to which their meet the criteria.</p> <p>The criteria are: 1- a plan to achieve the outcomes, 2- a plan about the project contributions to achieve the outcomes, 3- record of project participants, 4- freedom to operate in terms of IPR, 5- value for money or a cost effectiveness analysis of the project, 6- consistency with the objectives of GRDC plans and 7- effectiveness and quality of risk controls.</p> <p>Criteria are weighted differently for each priority and evaluation teams create a shortlist of best applications by calculating the scores under the priorities. The shortlist includes the applications that address the criteria,</p>	<p>provided on a regular basis.</p>	
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				<p>create proper value for money or benefits and appropriate risks. In the second phase of evaluation, GRDC asks the applicants to provide more detailed information about their proposals. Based on the assessments of detailed proposals, GRDC may start to negotiate with the applicants to select the best application for funding. After that and in the fifth step, progress reports and reviews are taken into account for making decisions about further resource allocation and finally, in the sixth step, final reports are assessed along with deliverables promised in the approved proposals.</p>		
<p>USB United States Revenue: There are about 570,000 registered soybean producers in the US who pay 0.5 percent of their sales price as the non-refundable checkoff. Half of this amount is allocated to</p>	<p>USB considerably interact with both public and private sector. In the case of USSEC, both USB and federal government fund this organization to enhance the market share of US</p>	<p>By law, USB can only spend up to 3% of its revenue on administrative costs. To deal with this constraint, this organization has defined three projects to</p>	<p>The board of directors identifies issues related to research interests. Based on the board decisions, USB provides a plan for allocation of resources and a preliminary budget. The budget is then</p>	<p>USB uses matrix format in the process of decision-making. In this matrix there are four target areas that are: domestic opportunities, international opportunities, supply and communication. In the same time there are four action teams that are meal, oil, freedom of operation and consumer focus. These action teams are based on strategic objectives of USB that are: increasing the values of soybean meal, enhancing the values of soybean oil, facilitating the freedom of operation for farmers and finally increase in the quality of soybean products to increase the demand for US soybean. So for</p>	<p>Every 3 year USB is supposed to conduct evaluation of its investments. The results of these performance measurements shows that on average USB's investments have yielded BCR of six in each year.</p>	<p>USB relies on several mechanisms to collect information about farmers' needs and research interests. Some of these mechanisms are: Survey of farmers' needs, Interaction with state level checkoff</p>

<p>USB (national level program) and the other half to state level checkoff program. On average each year farmers collectively pay about \$ 220 million as checkoff divided between national and state level. In 2014 USB revenue was \$109,775,559 USD</p> <p>Investment Portfolio: Meal, oil, freedom to operate, customer focus</p>	<p>soybean. In the case of production research, USB mostly rely on universities and other public organizations researches.</p>	<p>outsource an important part of it administrative activities. These projects are related to production research (supply), market development and communication. These projects are contracted to Smithbucklin, United Soybean Export Council (USSEC) and Osborn Barr respectively. The directors of USB are the state levels</p>	<p>reviewed by Agriculture Marketing Service (AMS) of United State Agriculture Department (USAD). If AMS approves the budget, USB request for proposals based on the decisions made in the board.</p>	<p>each target area there are four strategic objectives to follow and action teams are in charge of pursuing these targets. In the context of matrix, board members are first assigned to action teams and again for each action team they are divided into smaller groups. These small groups comprising three or four directors assigned to the target areas of their action team. In other words, there are 16 groups including three or four directors where each of these small groups becomes in charge of an action team for target areas. For instance, three or four members of board of directors decide about the issues and type of decisions that should be made for soybean oil in the case of production research (supply). In this system, the resource allocations' decisions for each target area are made with consideration of similar action team in the other areas. It means that the action teams are aware of issues in all of the target areas and they interactively make decision. The issues addressed in the matrix components are used as the preliminary resource allocation decisions. However, the staffs of primary contractors (Smithbucklin,</p>	<p>program. Inputs of board of directors as active farmers.</p>
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		<p>boards and in the USB level, states recommend these people to the federal government for appointment in USB board.</p> <p>There are 73 directors involved in USB decision-making. The number of directors from each state is the function of soybean production in the state. For instance, Iowa has four directors in USB board.</p>		<p>USSEC and Osborn Barr) provide program briefs related to their area in which they discuss the constraints, role of USB and issues related to decisions made. In the next step the directors and staffs related to each target area meet so to discuss the programs in more detail. In this stage, external experts might also be invited to discuss the possible outcomes and constraints of these programs. Based on the projections of checkoff revenues and other related information, board makes decisions about the allocation of available resources. These individual decisions become the USB's budget. The budget is then reviewed by Agriculture Marketing System (AMS) of United State Agriculture Department (USAD) and if AMS approves the budget, USB request for proposals.</p> <p>In the next step, researchers send their proposals. The researchers are supposed to provide following information: outputs and deliverables, probability of success or failure and quantifiable indicators of performance such as adoption rate or other indicators showing a change in farming practices of farmers as a result of output of the project.</p> <p>and the target area's staffs provide a</p>	
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				summary of these proposals for the board of directors assigned to that target areas. These summaries include information about possible outcomes, chance of success and other technical information. The type of information provided about the possible outcomes is different for different action teams. For instance, those projects related to the industrial use of soybean provide more detail information about the effect of a proposed research on demand for soybean. In another example, USB conducts an annual survey in which it collects information about the effect of different diseases on the production all around the US. These surveys are finally used for evaluation of proposals sent to USB that are related to soybean diseases. Based on these summaries, board of directors decides whether to fund the project or reject it.		
Iowa Soybean Checkoff Program (ISCP) (US) Checkoff Revenue in 2015: 11,000,000 US dollars Crop:	Iowa Soybean encompasses two organizations that are ISCP and Iowa Soybean Association where the latter focuses	ISCP collects 0.5 of 0.5 cents per bushel as checkoff. There are nine crop districts in Iowa where each district	Based on the priorities determined by board, research managers in ISCP provide RFP. The RFPs are sent to three groups that are	Every year directors and staff get together in March and discuss the issues and possible plans to address those issues. After the discussions board of directors decides about the priorities that need to be addressed. These processes are based on voting and in recent years, board of directors in Iowa soybean has voted for investment in agronomic researches,	In the case of individual projects progress and final reports are used as the performance measures. ISCP has created key	ISCP several sources to find out about farmers needs and research interests that are: -Information collected by on-farm group

<p>Soybean Research investment portfolio:</p> <ul style="list-style-type: none"> -Germplasm by focus on yield increase -Breeding -disease, nematode, pest and insect -weed management -nutrient management of soybean -water quality -agronomics 	<p>mostly on policy and it cannot use checkoff money for that purpose. ISCP mostly collaborate with Iowa State University and in average it has invested \$3 million dollars in this university per year from its establishment. In addition, it has close connection with other soybean checkoff programs in federal and state levels. In the state levels ISCP collaborate with 11 states located at north and</p>	<p>has two representatives in ISCP and in general 21 member boards are elected from the whole state.</p>	<p>board members of ISCP, research managers in other checkoff programs and research manager in USB. The last two groups usually receive the RFPs to inform ISCP about possibility of overlapping investments. After that the potential researchers are informed about the priorities of ISCP. The researchers are asked to submit proposals that are 5 to 7 pages. A proposal should clearly indicate that it would provide</p>	<p>infrastructures and market promotion as the main priorities respectively. After the determination of priorities, staffs of Iowa Soybean provide a preliminary budget based on the priorities determined by board. In another meeting held in June of each year, board of directors and staffs discuss the preliminary budget and board make the final decisions about the allocation of resources. There are four committees including supply (production research), demand (new uses, biodiesel, international marketing and soybean meal), policy and information and education (provide information about farm management and communication with farmers about the results of ISCP research results and their extensions). In the case of production research, the resources are allocated between four main areas that are:</p> <ol style="list-style-type: none"> 1-On-farm group: this group collects information from soybean farms and informing farmers about new solutions for agronomic issues. 2-Environmental services: testing water and soil quality for soybean farmers and outside organizations with the use of ISCP own water quality lab 3-North Central Soybean Research Program (NCSRP): NCSRP 	<p>performance indicators used to measure the performance of this organization toward its objectives.</p>	<ul style="list-style-type: none"> -Information shared in NCSRP by other states -Inputs from board members as active farmers.
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	<p>central parts of US. This collaboration is in the form of an organization called North Central Soybean Research Program (NCSRP). NCSRP includes 12 soybean checkoff programs and its job is the investments in the research gaps that are common between these states. ISCP's research manager currently governs NCSRP.</p>		<p>proper return to investment. Especially in the case of applied researches, ISCP ask the researchers to provide economic impact of researches. Furthermore, the researchers should illustrate the key performance indicators and the methods by which KPIs are measured. Researchers have to show how the results benefit soybean farmers both in long run and short-run.</p>	<p>encompasses 12 states located at the north central US and producing soybean. The investments in NCSRP are primarily related to common issues of the 12 states in soybean production. 4-Investment in research project and collaboration with Iowa State University (ISU): ISCP extensively collaborates with ISU and in average it has invested \$3 million dollar in this university during the recent years. Board of directors mostly monitors the performances of the first three investment themes and do not make direct decisions about their investments. Furthermore, on-farm and environmental services teams usually leverage their funds either by collaboration with other organizations or providing services for outside firms. In the fourth case, ISCP request for proposals based on the priorities and objectives determined by board of directors. The proposals are then sent to ISCP and research program staffs provide information about the proposals for board members. The board discusses these proposals and their consistencies with ISCP priorities. Based on these discussions, directors decide about those proposals that should be funded by ISCP.</p>		
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<p>Iowa Corn Promotion Board (ICPB) (US) Checkoff Revenue in 2015: 17,213,411 US dollars</p> <p>Crop: Corn</p> <p>Research investment portfolio:</p> <ul style="list-style-type: none"> -Corn Utilization (Bio-Plastics) -Genomic improvement -Efficiency of Nitrogen use 	<p>ICPB extensively cooperate with Iowa state university. ICPB primarily works with universities and private labs for conducting research. Based on the recent decisions in IC, a part of IPRs of the patented researches should belong to this organization as well. However, before this decision, only the research partners would own the IPRs. IC is interested</p>	<p>ICPB's checkoff is 1 cent per bushel and it is refundable. The checkoff is spent on R&D, market promotion, funding start-up companies and commercial deployment of technologies .</p> <p>Iowa corn encompasses two organizations that are ICPB and Iowa corn association. The former is in charge</p>	<p>There is no call for proposals in ICPB as staff and board members of ICPBs define the projects.</p>	<p>The members of board of directors determine the priorities. The research committee has determined two main areas as the priorities of the organization that are expansion of corn's industrial usage and genetic improvement. In the former priority, ICPB focuses on replacing petroleum based products with renewable products from corn. In this case ICPB decided not to increase the role of corn in production of processed foods to avoid competition with other commodities to produce food. After the identification of priorities, ICPB uses industrial consultants to elaborate the technical issues related to the priorities. Using the priorities and consulting with external experts, ICPB defines a handful of projects. In the next step ICPB with the help of consultant conducts a preliminary analysis of market for the defined projects including, market opportunities, volume, competition and possible role of IC. After that the ICPB decides about the best possible research partners. The main criteria used by ICPB to determine the projects to fund are market volume, cost of production and</p>	<p>ICPB evaluates its performance based on pre-defined milestones. In addition, an important performance measure in the case of research is the number of patent this organization has gained.</p>	<p>ICPB uses two sources to find out about farmers needs and research interests that are survey of farmers and inputs from board of directors.</p>
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	<p>to differentiate itself from public and private sectors. By focusing on the researches that are in the interests of public. In addition, ICPB tries to fund projects that improve industrial usage of corn in early stage of production.</p>	<p>of that is in charge of market development and research and education and the latter pursues policy related issues and lobbying. These two organizations have separate board of directors but they meet in the same time and the staffs of Iowa corn works for both of them. The directors are elected by farmers and represent</p>		<p>patentability of the projects.</p>		
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		specific districts in Iowa. The board is divided into five committees including industrial usage, export, R&D, membership and checkoff and finally environmental issues.				
KWC (US) Revenue in 2014: 4,564,259 Crop: Wheat Research investment portfolio: -New Variety development	KWC has close collaboration with two other organizations in Kansas that are Kansas Wheat Alliance and Kansas Crop Improvement Association.	KWC was established in 1957 by legislation and in 2012 it was privatized. Wheat farmers in Kansas voluntarily pay 2 cents	Based on priorities determined by board of directors, KWC along with two other organizations in Kansas that are Kansas Wheat Alliance and	Board of directors is in charge of determining priorities in KWC. The main component of priorities in KWC is its four ongoing breeding programs, so if a LOIs is consistent with these programs, the research committee will ask for full proposals. In average more than 90% of LOIs are approved and about 45% of the proposals are funded. After sending full proposals, all the researchers are invited to a one-day	For individual projects, KWC asks for annual progress report, reviewed by the staff. However, there are no general performance measures used by KWC.	The main focus of KWC is on its four breeding programs. Therefore, an important part of its investments are related to these programs. In other issues, KWC relies mostly on board

<p>-Production (agronomy)</p> <p>-Trait discovery and biotechnology</p> <p>-Testing new technologies and methods</p> <p>-Industrial use</p> <p>-Consumer preferences</p>	<p>These three organizations call for proposals in the same time, however the proposals are divided between these organizations based on their goals that might be different. In addition, KWC collaborate with wheat commissions in other central states of the US to avoid overlapping.</p>	<p>per bushel “wheat assessment”</p> <p>. There are 9 directors in KWC elected by farmers. In general, 7 of the directors represent 9 districts in Kansas and 2 of them are directors at large.</p>	<p>Kansas Crop Improvement Association request for proposals. In the first step the researchers are supposed to send LOIs. If research committee approves the LOIs (In average more than 90% of LOIs are approved) the researchers receive invitation to submit full proposals.</p>	<p>meeting in which they are asked to present their proposals and ideas for research committee.</p> <p>In this meeting the research committee members use a scoring sheet to score the following criterions:</p> <p>1-Relevance of the project with KWC breeding program, 2-Potential for high return to investment, 3-consistency with priorities of KWC, 4-innovativeness and 5-consistency of budget requested and scope of the project. Each criterion can be scored from five (excellent) to one (poor). At the end of the meeting the scores of criterions for each project are added together where relevance to KWC breeding program has the highest weight. Based on the scores and discussions, projects are ranked and recommended to board of directors to make final decisions. External expertise might be used in the decision-making process in case they are needed.</p> <p>KWC has its own research lab run by a for-profit company in KWC to conduct some of the researches as well. The lab’s main focus is on genetic improvement of wheat varieties.</p>		<p>of directors’ inputs as active farmers.</p>
Montana Wheat	MWBC	MWBC was	Based on	Research committee reviews the	For individual	A majority of

<p>and Barley Committee (MWBC) (US) Revenue in 2015: 4,550,808 US dollars where 90% of this amount is related to wheat assessment. Crop: Wheat and Barley Research investment portfolio:</p> <ul style="list-style-type: none"> -New Variety development -Production (agronomy) -Cropping system -Weed and Disease 	<p>extensively cooperate with Montana State University. MWBC supports most of wheat and barley breeding programs in Montana State University.</p>	<p>established more than 40 years ago. In 1967 and by legislation MWBC officially became in charge of collecting wheat and later barley assessment. Currently wheat producers in Montana pay 2 cents per bushel of and barley producers pay 3 cents per bushel of hundred weights as the checkoff. Directors in MWBC are the representati</p>	<p>priorities determined by board of directors and research committee in MWBC requests for proposals. Researchers are supposed to submit the full proposals in which methods and benefits for wheat and barley producers of Montana should be indicated.</p>	<p>proposals categorizes them into high, medium and low groups. The categorizing in this stage is primarily based on the personal opinions and farm experiences of board members. Those proposals that are classified as high value are very likely to be funded. However, in the case of those proposals that are considered as middle value, research committee discusses the possible benefits and costs of these projects. At the end of this stage, the research committee again ranks the middle value projects from high to low. In this process, MWBC may ask experts to provide their expertise. However, this does not happen on a regular basis and research committee is more likely to rely on its members' opinions to fund a proposal. The ranking in each stage is based on majority voting rule and not consensus among the members.</p>	<p>projects, progress and annual reports are used as the performance measures of MWBC. Montana State University provides reports including following information of projects funded by MWBC in past and present:</p> <ul style="list-style-type: none"> -Investigation of cropping system -Investigations of varieties performances -Disease and weeds managements 	<p>researches funded by MWBC are long-lasting projects (such as breeding programs) and therefore, this organization does not conduct surveys to collect farmers' feedbacks and information. MWBC mostly relies on the inputs of the directors and information provided by Montana grower association.</p>
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		<p>ves of seven districts in state of Montana. Farming organizations in each region recommend a person for appointment in the board of directors of MWBC and Governor of Montana appoints the board members based on the recommendations. Board members at most can serve for 3 terms (nine years where each term is three years).</p>				
SCDC	SCDC has	SCDC	There are three	Research committee reviews the LOIs	In the case of	There are three

<p>Canada</p> <p>Revenue: 4,828,000</p> <p>Crop: Canola</p> <p>Research Investment Portfolio: 1-Agronomic 2-Genetic improvement 3-Utilization</p>	<p>considerable amount of collaboration with Canola Council of Canada (CCC) and Canadian Canola Grower Association (CCGA). In most of the cases, these organizations have clear division of labors regarding the policy tasks in provincial, national and international levels. These organizations also have partnership for investment in research projects. SCDC also has recently signed non-disclosure</p>	<p>collects checkoff of 0.75 cents per ton. Farmers in Saskatchewan elect eight members of board of directors for four years.</p>	<p>sources used by SCDC to solicit proposals that are: 1-SCDC own call 2-Partnership with ADF 3-Partnership with CCC In this process, first LOIs sent to SCDC and based on the board's decision, researchers are invited to send the full proposals.</p>	<p>and asks for full proposals. A LOIs is ruled out if its topic has already been covered in previous researches. Research committee reviews the full proposals sent by researchers. In this process, research committee highly relies on external advisors reviewing the proposals. The external advisors are mostly plant scientists that evaluate the scientific merits of proposals. At the final step research committee provide recommendations for board of directors where the final decisions about projects funding are made.</p>	<p>individual projects, SCDC relies on progress and final reports provided by researchers. There are no general performance measures in SCDC.</p>	<p>main sources of collecting farmers' feedbacks and research interests that are: 1-interaction with CCC and CCGA 2-Discovery Forum: CCC organizes the forum where researches funded by SCDC and other organizations are presented for farmers. In this meetings farmers also talk about their current issues in the farms. In these meeting, the issues discussed by producers are taken into consideration as the future research topics.</p>
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	<p>agreements with some of the private companies engaging in Canola research. Based on the agreements SCDC tries to find out kinds of researches are conducted in the private companies. Using this knowledge, SCDC can direct its investment in those areas that are not covered by private sector. In addition, SCDC tries to distinguish itself from other sectors by investing on those researches that are not highly</p>					<p>3-Inputs from board of directors as active farmers.</p>
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	attractive for private and public sectors and in the same time might bring values for farmers.					
GFO (Canada) Checkoff Revenue in 2014: 8,800,00 Crops: Barley Oat Soybean Wheat Corn Research Investment portfolio: -Agronomy and production -Weed, Disease and insect pest control -Breeding and Genetics -Crop quality and utilization	GFO mostly collaborate with Guelf University and it also works with federal and provincial to co-fund some of the projects. It also has partnership with other checkoff program in the form of co-funding projects, especially for breeding programs. Furthermore, GFO tries to differentiate	GFO is the results of merger between several grower organization s including Ontario corn producers' association, Ontario wheat producers' marketing board, Ontario soybean producers and finally oat and barley growers of Ontario.	GFO has RFPs and they are based on this organization's priorities. In the proposals, researchers should provide following information: objectives, methods, and "incremental value" to farmers of Ontario and finally "tangible" deliverables and outputs.	In each year GFO conducts interview with farmers, crop advisors, government experts, scientist as well as its board members to identifies research priorities. Research committee review the information collected by interviews and decides what the properties are. For instance, in current year GFO's main priority in agronomy is related to soils issues where this priority was determined by growers' recommendations. GFO requests for proposals based on the priorities and researchers send their proposals. The staff reviews the proposals by use of their expertise as well as external reviewers and scientists. The reviews of proposal conducted by staffs and external experts are sent to research committee. This committee as a subset of board of directors discusses the proposals and interviews and	There are no formal performance measures in the case of research investments. In the case of individual projects GFO primarily relies on interim and final reports.	GFO conducts several interviews and surveys between farmers, scientists and other experts to find out about the main issues that should be addressed in its investments. In addition, directors' inputs as active farmers play important role in determination of investments directions.

	itself from private and public sector by the choice of projects and focus on funding projects that benefit public.	GFO has 15 directors representing 15 districts in Ontario. Farmers elect the directors of GFO.		finally it provides recommendations for board of directors to make final decisions. Two of the most important criterions to assess a proposal are its relevance to crops grown in Ontario and feasibility of conducting the project.		
Agriculture Development Fund (ADF) (Canada) Budget in 2014: 6,867,000 Crops: Several crops Research Investment portfolio: -Agronomy and production -Weed, Disease and insect pest control -Breeding and Genetics -Crop quality and utilization -Production risk	ADF extensively collaborate with checkoff programs in the province. This organization is involved co-funding and providing investments projects for these organizations. It has also close collaboration with universities especially University of Saskatchewan.	ADF is a part of ministry of agriculture in Saskatchewan. Advisory committee assigned by minister of agriculture makes the main decisions in this organization . Advisory committee of ADF contains 10 members	ADF has call for proposals. It is the main source of call for proposals for checkoff programs in Saskatchewan. In each year ADF request for proposals based on its strategic plans and outcomes. However, in some cases and in the presence of specific issues, ADF request for proposal for specific projects.	As ADF receives the LOIs they are usually sent to two experts. The first expert is a member of regional offices in Saskatchewan ministry of agriculture. This expert is supposed to provide information about the importance and applicability of research topic in LOIs with producers' needs and research interests. The second expert is a scientist that evaluates the scientific merits of LOIs. In addition, the LOIs are evaluated based on the following criteria: 1-consistency with strategic goals and outcomes 2-addressing gap in the research area and uniqueness 3-benefiting Ag-Food industry in the province 4-finacial contribution and collaboration from other parties (including checkoff programs). If a LOI meets the above criteria and	There are no formal performance measures in the case of research investments. In the case of individual projects ADF primarily relies on interim and final reports.	ADF primarily relies on the regional offices to collect information and feedback from farmers. There are 10 regional offices located at different part of Saskatchewan are in charge of interaction with agriculture industry to provide them with the industry with information about production and business. In addition,

	<p>In the case of private sectors, it also has some collaboration.</p>	<p>(seven from industry and three from ministry of agriculture) divided into smaller groups such as crop and livestock sub-committees.</p>	<p>In the first step the researchers are supposed to send LOIs and if LOIs are approved, ADF invite the researchers to submit the full proposals.</p>	<p>is approved by experts, it will be sent to ADF advisory committee. The committee then invites the researchers to submit the full proposals. In this process if the members of advisory committee have different opinions about the merits of a project such that some members believe the project is valuable and some not, ADF will ask for full proposal regardless of the differences. However, ADF will ask the researcher(s) to address issues raised by the members that were sceptical about the project. The full proposals are evaluated based on the following criteria: A-strategic alignment including 1-consistency with strategic goals and outcomes of ADF, 2-support from industry B-feasibility and scientific merit C-Impact including 1-economic effect, 2-adoption by industry, 3- impact on environment. In average 50% of LOIs are rejected and the other 50% are invited to send full proposals. Furthermore, 80 to 90% of researches that are approved for submitting the full proposals are funded. In this process industry supports play important roles to choose between projects with similar merits.</p>		<p>seven members of advisory committee are from agriculture industry that can provide information about the needs and gaps for research. For instance, crop producers can meet with the regional offices and ask them about their problems and needs that in fact can represent the research interests for farmers. Regional offices' experts also play important roles in the evaluation of LOIs. ADF has close relationships with checkoff programs that</p>
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						could be provide proper information about needs and research interests. Seven out of 10 members of ADF's advisory committee are from industry that in fact can reflect the research interests.
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Appendix C: Cobb-Douglass decision-making function.

The choice of δ in the case of Cobb-Douglass decision-making function.

Stage 3: The return function of the PCRO is in Cobb-Douglass form as it is indicated in equation C.1 where I assume that manager and the board have the same knowledge levels and equal to 1.

$$\pi = (e_M)^{1-\delta}(e_B)^\delta - F - b\alpha_y((e_M)^{1-\delta}(e_B)^\delta) \quad C.1$$

The manager's net utility function is shown in equation C.2

$$U_M = F + b\alpha_y((e_M)^{1-\delta}(e_B)^\delta) - \frac{1}{2}c_M e_M^2 \quad C.2$$

The board's net utility function given the optimum fixed payment from the PCROs point of view is illustrated in equation B.3:

$$U_B = x \cdot ((e_M)^{1-\delta}(e_B)^\delta - \bar{w} - \frac{1}{2}c_M e_M^2) - \frac{1}{2}c_B e_B^2 \quad C.3$$

where $x = \rho + \theta$ representing altruism and personal gains of the board members

The manager and the board both maximize their utility with respect to their efforts (*i. e.* e_M and e_B). Consequently, the efforts exerted by the manager and boards are:

$$e_M^* = (1 - \delta) b \alpha_y \left(\frac{\delta x}{(1-\delta) b \alpha_y c_B} \frac{c_M}{c_B} \right)^{\frac{1}{2}\delta} \quad C.4$$

$$e_B^* = \left[\delta \frac{x}{c_B} \left(\left(\frac{\delta x}{(1-\delta) b \alpha_y c_B} \right)^{\frac{1}{2}\delta} \frac{1}{c_M} (1 - \delta) b \alpha_y \right)^{1-\delta} \right]^{\frac{1}{2-\delta}} \quad C.5$$

Stage 2:

In this stage the optimal bonus paid to the manager is determined. Therefore, the PCRO maximize its net return with respect to the bonus of b and I have:

$$b^* = \frac{2}{(2-\delta)(1+\sigma_y^2)} \quad C.6$$

Stage 1:

Given the optimal b^* shown in equation B.6 I now try to indicate the choice of δ considering the Figures B.1 and B.2 show the choice of δ where the arbitrary values of the model

parameters are $\bar{w} = 1/10$, $\sigma_y^2 = 1/10$ and $c_B = 1$. However, in figure B.1 I assume the board is highly altruistic ($x = 1$) while in figure B.2 it is assumed the board is primarily after its personal agenda ($x = 1/100$). In these two situations I indicate the choice of δ given the relative marginal cost of the manager to the board members.

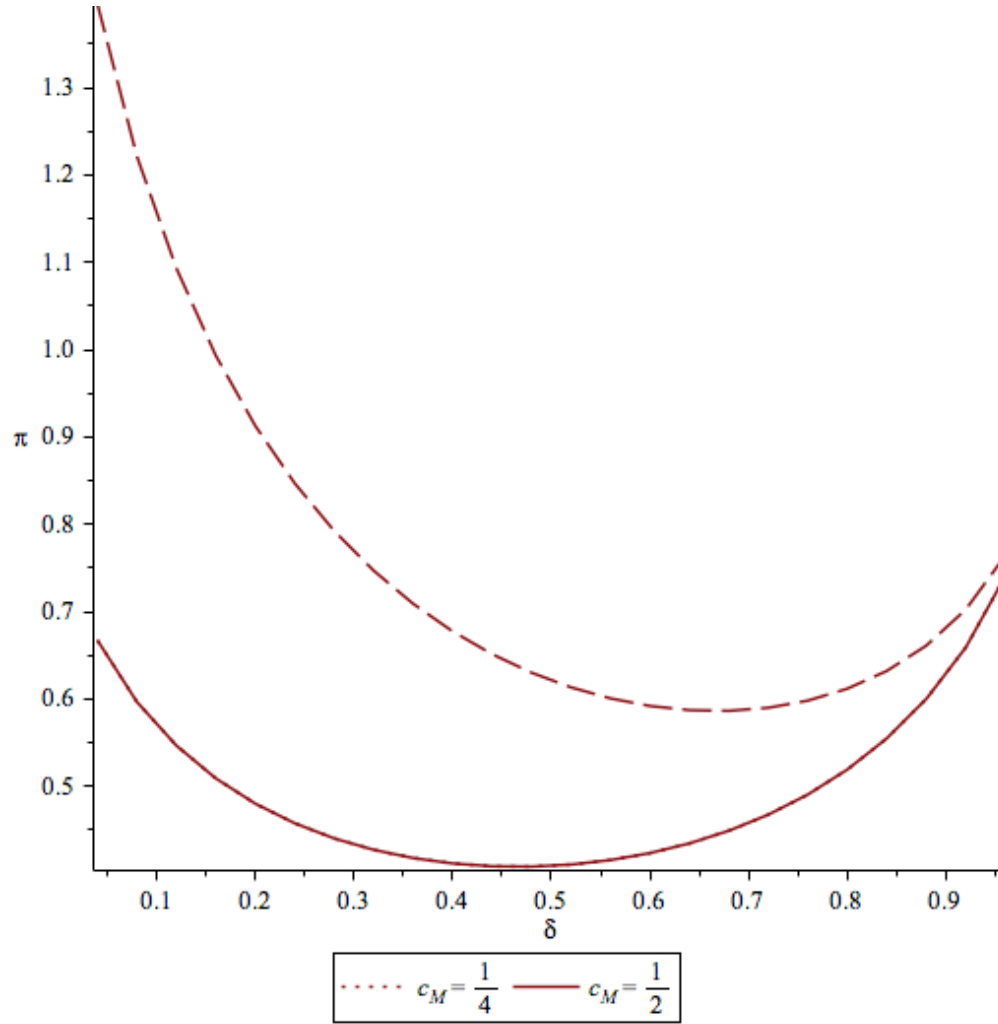


Figure. C.1. The choice of δ where $\bar{w} = 0.1$, $\sigma_y^2 = 0.1$, $x = 1$. $C_B = 1$

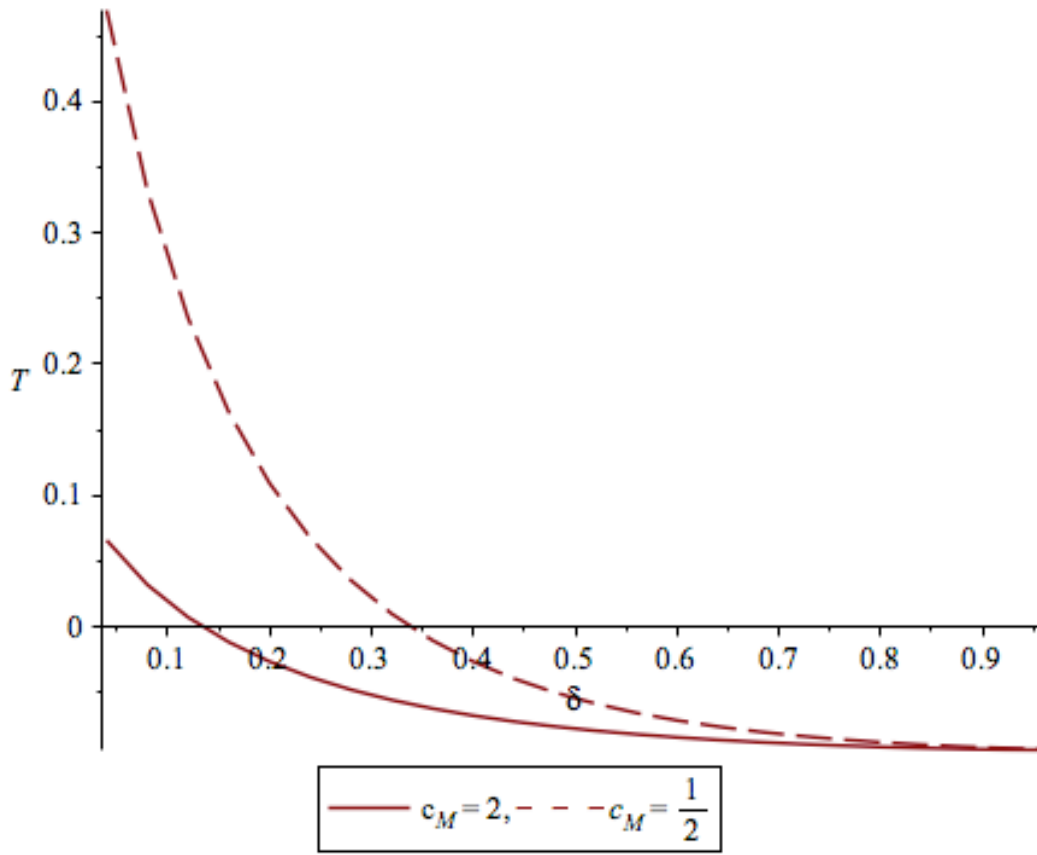


Figure. C.1. The choice of δ where $\bar{w} = 0.1, \sigma_y^2 = 0.1, x = 1, C_B = 1$

Thus as it is indicated in figure B.1, one can see that in the presence of a highly altruistic board, the board's share in the decision-making process approaches to zero if the manager's marginal cost of spending effort is notably lower than the board of directors' marginal cost (*i. e.* $\frac{c_B}{c_M} = 4$). However, in the case of $\frac{c_B}{c_M} = 2$ the PCROs still prefers to assign considerable part of the decision-making to the board.

Figure B.2 illustrates that if the board is primarily after personal gains, the manager will take over the decision-making assignment even if his marginal cost of exerting effort is significantly more than the board' marginal cost (*i. e.* $\frac{c_B}{c_M} = 2$). Therefore, one can see that even in the presence of a Cobb-Douglass decision-making function, the PCRO still prefers to delegate most of the decision-making assignment to one of the agents.